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VALVES FOR GAS AND OTHER PURPOSES.

A SLIDE-VALVE is one whose disc or gate slides backward and forward over the opening or orifice through which the flow takes place.

Slide-valves raised by a screw, actuated by a handle, were in existence on water-mains long before gas was practically applied for lighting. They were worked by a screw, because the pressure of water in pipes is usually great, and as the water is heavy, it is apt to break the valve or burst the main if the momentum of its flow is suddenly arrested. Neither of these reasons applies to gas, therefore it is not essential that the comparatively slow motion obtained by the screw should be continued with valves of that description, hence the rack and pinion valve was introduced, which admits of the opening of the slide or gate with a few turns of the handle or handwheel.

One description of slide-valve is shown in the annexed engravings. This represents one of the earlier forms. Fig. 5 is a vertical section, fig. 6 a sectional plan, and fig. 7 a section through the valve-chamber. A is a cast-iron disc, faced to fit gas-tight, and pressed by the spring, B, against the part, C, of the valve-box, which is also faced. The disc or door, A, on being raised or depressed by the screw, D, opens or closes the gas passage. E is a stuffing box through which the screw-spindle works. The latter has a collar upon it, as shown, working in a socket, to prevent the spindle or shaft from rising on being turned by the handle, the disc only being raised and lowered by the action of the screw. The upper dotted circle in fig. 7 is intended to show the position of the door when the valve is open.

A rack and pinion valve, known as Donkin's valve, is illustrated in figs. 8 and 2, the former being a section through the center, and the latter a back internal view. This valve, if fixed above ground, may be placed in the upright position as shown, and if connected to mains underground, it may be laid on its side, with the spindle pointing upwards. It is particularly well adapted for shallow mains, as the vertical space it occupies is little more than that taken up by the diameter of the main itself.

Great difficulty was experienced for years in obtaining a slide-valve, whether actuated by a screw or a rack and pinion, that was absolutely gas-tight, or that would remain so for a reasonable time under all the conditions of its working. Comparatively few valves came up to this standard of perfection. There was, generally, more or less of leakage past the gate after they had been in use a short time, and their defects in this respect increased as the deposit of particles of tar and naphthaline accumulated and hardened upon their surfaces. The faced parts were frequently not tight in the first instance, or the whole valve was made so light as to be easily sprung in the fixing or the working.

Gas machinery and apparatus of all kinds have undergone improvement within the past twenty-five years, and slide valves are now constructed of the best materials, of proper strength, and of such excellence in workmanship by different makers, as to justify the highest encomiums in their praise.

Valves, wherever fixed, should be accessible, in order that the cover or bonnet may be easily taken off when required to give access to the interior for cleaning or repair, and with that view, when laid in the ground, they should be placed in a cast-iron box pierced for the main at opposite sides, or in a space bricked round, and covered by a flag or other movable top.—*Journal of Gas Lighting*.

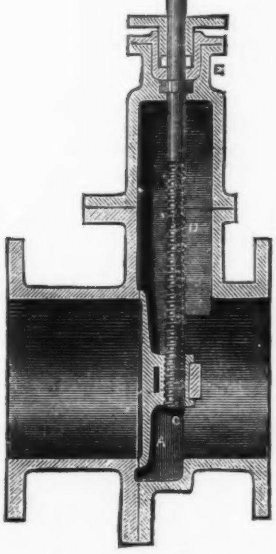


Fig. 5.

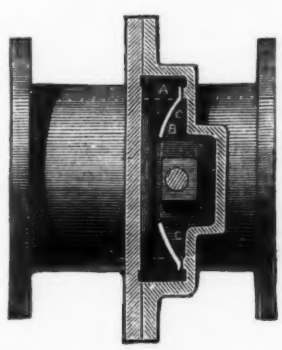


Fig. 6.

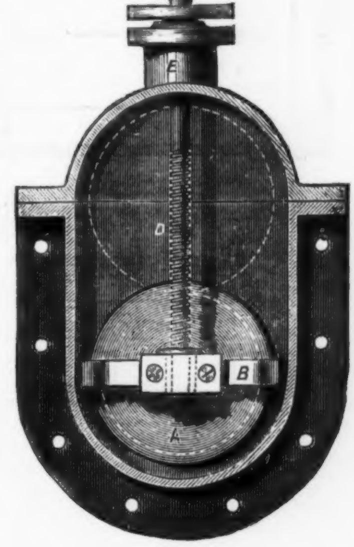


Fig. 7.

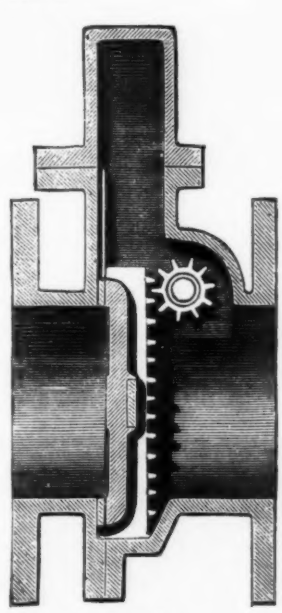


Fig. 8.

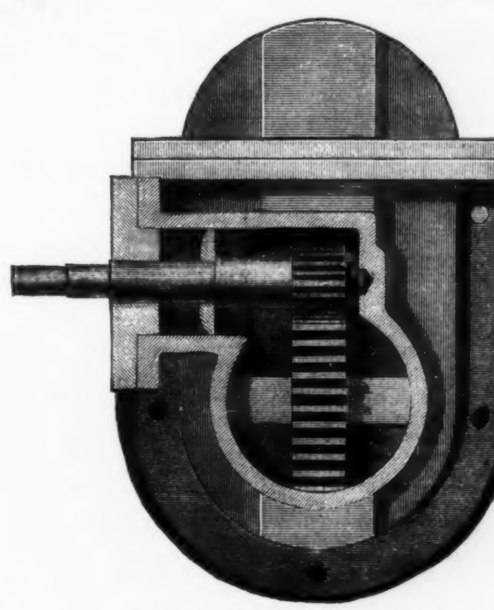


Fig 9

VALVES FOR GAS AND OTHER PURPOSES.

ON THE ARTIFICIAL PRODUCTION OF ICE.

THE production of ice by mechanical means is now extensively carried on in Manchester, Eng., by the Manchester Ice Making Company. A very large ice-making plant is used, constructed on Messrs. Siddeley & Mackay's patent, and supplied to the Company by Messrs. Siddeley & Co., of Liverpool, and which, apart from its size, includes several features of special interest. The following description we find in *Engineering:*

The "working fluid," as it may be called, in Messrs. Siddeley & Co.'s ice-making machines is sulphuric ether, this ether being vaporized in a partial vacuum and absorbing heat from brine during its vaporization, the vapor thus produced being subsequently compressed and delivered into a condenser, where it is liquified, to be again subsequently vaporized, and so on through a continuous cycle of operations.

The general arrangement of the plant at the Manchester Ice Company's Works is shown by the plan which we annex. The power which is used to produce the circulation of the ether and the brine through the apparatus is derived from a Galloway boiler 6 ft. 6 in. diameter by 22 ft. long The steam is supplied at 55 lb pressure to a pair of horizontal compound engines, having respectively a high-pressure cylinder 18 in. diameter, and a low-pressure cylinder 28 in. diameter, the stroke in both cases being 3 ft. 3 in. The

engine air pump is driven off the crankshaft by means of a small vibrating beam at the end of the high-pressure engine bed and is vertical. The condenser is vertical also, and is of large size. Steam is cut off in the high-pressure cylinder at half stroke. All the connections of steam and exhaust, etc., are such that in the event of any emergency, either one or the other engine can be worked alone, or either one by high pressure only, or either as a condensing engine. Every part of the pumping power arrangement is thus so duplicated that in the event of any partial breakdown, the work may be continued by the other portion of the engine without a moment's stoppage. The ether vacuum pumps are horizontal, and worked direct from the piston rods of the steam cylinders; they are 34 in. diameter by 3 ft. 3 in. stroke. Two water circulating pumps are provided for the pumping of the brine and the fresh water through the various portions of the establishment, and are driven by the same pair of engines. In the engraving we give below, showing the plan of these engines, the arrangement of the parts above mentioned will be easily understood by reference to the letters thereupon. A is the high pressure cylinder, B the low-pressure cylinder, C C the two ether vacuum pumps, D D the water circulating pumps, E the feed pump for boiler, F the engine or air pump, G the engine condenser, *h h* the governors, and *i* and *k* pipes connecting the vacuum pumps with the ether condensers.

natural temperature of the supply, 62°, and passes off warmed to 74° by heat absorbed from the ether vapor within the tubes. The warmed water is pumped up to a tank elevated to the highest part of the building, from whence it is allowed to descend in contact with the surrounding atmosphere, by which means it becomes cooled ready for re-use.

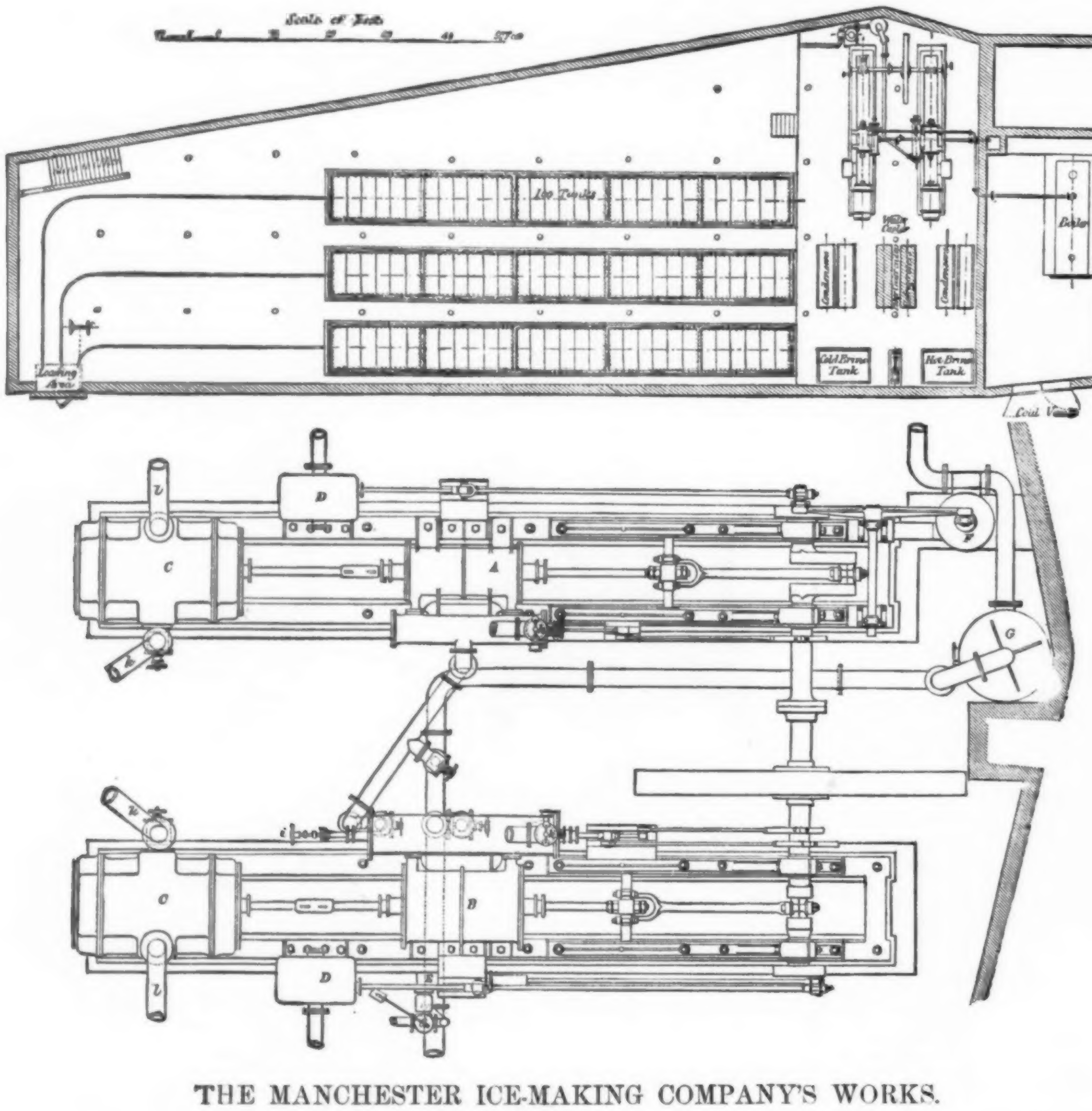
We have thus traced the ether in its course from its first start through the various processes of its evaporation and condensation, showing that the great reduction in its temperature is made use of first to cool brine to a very low temperature, then to cool the returning liquefied ether in preparation for its next evaporation, and in this process lies one part of the economy which results in commercial success.

Returning for awhile to the ether, which is sent back to the first vessel or brine refrigerator it must be explained that another important apparatus intervenes between the inflowing supply of liquid ether, which is at a pressure of 3 lb. per square inch, and the refrigerator from which it is to pass under the vacuum of 23 in. to the pump. This is the governor, which is another of the patented portions of Messrs. Siddeley & Mackay's machinery, consisting of a small vessel containing an inverted valve attached to a lever and balance-weight, and a ball float. The adjustments of this governor are such, that as the vessel becomes filled with

tank No. 2, whence it passes on to tank No. 3 at, say, 28°, and finally out from No. 4 at 32°. The water supplied to No. 4 thus is the first to become congealed in regular course, and forms the outer shell of the future block. After a period of, say, 12 hours, the flow of brine is changed, and that of a cooler temperature, viz., 24° (to be raised to 28° by its duty), is made to flow round this tank in place of that which had been circulating, and again in another 12 hours the next change is made, and brine of about 22° (about to be raised to 24°) is made to flow round the same tank, and a final flow of fresh brine from the refrigerator at the greatest degree of cold, finishes off the block and leaves it at that temperature or thereabouts. Thus no very sudden changes of temperature are brought to bear upon any portion of the structure, and economy of result as well as duration of parts is insured.

The ice thus made is much colder than any imported ice can be, and has its advantages in that respect. It is also in a convenient form for transport, and if made as at Manchester, in the midst of a vast city, it is ready for use at once and saves the cost of expensive ice-wells, as its manufacture is a steady and regular process, continued, if need be, from one end of the week to the other in an unbroken course.

The next feature of economy is also a very important one. The tank of ice blocks, when frozen, has to be cleared. The



THE MANCHESTER ICE-MAKING COMPANY'S WORKS.

In dealing with the cycle of operations of which we have sketched the outline above, we will commence with the liquid ether as it is in contact with the brine-cooling surfaces from which it has to absorb heat. The brine cooling apparatus is a vessel like an ordinary surface condenser, traversed by tubes which are charged by strong brine. The ether which is in contact with the exterior of the tubes is here vaporized under a vacuum of about 23½ in. of mercury, and at a temperature of 21°, the vapor being drawn off by the ether pump which then compresses and delivers it to the ether condenser at a pressure of about 3 lb. per square inch and temperature of 110°. The ether vapor, however, does not pass direct from the brine refrigerator into the ether pump, but is on its way to the latter first caused to pass through a tubular vessel in which is contained the liquefied ether on its return journey for re-use. The vaporized ether here absorbs some of the heat contained in this returning liquid ether, and becomes somewhat warmer in consequence, and passing onward it finally flows into the vacuum pump, not at 21° as it left the brine, but warmed to 45°. The compression it receives by the vacuum piston as it is driven out of the pump raises the temperature to 110° as already mentioned. The arrangements here mentioned form special features in Messrs. Siddeley & Mackay's patent, and it is noticeable that there is no appearance of external condensation or hoar frost upon the pipes and pumps, which, if visible, would be a clear proof of heat being absorbed from the surrounding atmosphere to the detriment of the end in view.

The ether vapor discharged from the pump at a 3 lb. pressure and 110° temperature, passes through a surface condenser formed of small horizontal copper tubes fixed into metal tube plate chambers at each end, round about which tubes is a constant stream of water, flowing in at the bottom and out at the top of the chamber. This water enters at the

the returning supply of ether, the valve becomes depressed by the weight of the supply, and some portion of the fluid is permitted to pass away to the refrigerator, but only so much as allows the valve again to close, and maintain the relative differences of pressure unimpaired. A glass gauge fixed on to the side of this vessel shows the height at which the ether is constantly and automatically kept by this governor, and the proof of its efficacy is apparent to an observer, for the regular rise and fall can be clearly seen.

We must now follow the course of the brine, cooled to a temperature of 21°, which has been prepared as we have described, and which, having been thus cooled, is ready for the purpose for which it has been formed, viz., the production of pure and clear ice for commerce. The water to be frozen passes into a series of tanks formed of wrought and cast iron water spaces or walls, about 3 in. thick and about 4 ft. deep, placed vertically, and connected at the ends and in the center of their length in such a manner as to form a number of cells about 3 ft. 6 in. long, 4 ft. deep, and 12 in. wide, the bottom being somewhat narrower than the top to facilitate the removal of the slab of ice when frozen. There are 3 rows of these tanks, each row being subdivided into 6 main divisions containing 24 cells. When it is desired that the process of freezing shall begin, the cold brine is caused to pass first of all through the walls of a tank containing cells of cold water. These cells of water in due course become frozen throughout by the continual flow of cold brine at an initial temperature of 21° through the 3 in. water space walls. In regular and constant work, however, the arrangement differs somewhat, for it is desirable that the currents of cooling fluid and of water to be cooled shall circulate in opposite directions. Therefore, in practice, the brine of 21° temperature is passed through a tank of ice that is approaching its completion in the process of freezing, and then having been warmed by this duty to, say, 24°, it is passed into

blocks are fast to the cells, and are surrounded with brine at 21°. It is necessary to warm the cells, but it would be expensive to warm the surrounding cold brine also. Therefore, there are two tanks provided, one for the reception of the cold brine, and another for the purpose of containing and supplying warm brine.

A special donkey pump is placed in communication with the tank to be cleared, and it begins to pump warm brine into the tank containing the frozen blocks and the delivery pipe is opened to the receiving tank for cold brine. It is found that the donkey pump will thus force warm brine into the tank of slabs or cells for about an hour, and the outflow of water will be still very cold. Having a thermometer placed in the outflow, the attendant is enabled to notice directly the temperature rises to the required point, and he then shuts off the communication to that tank which it is evident has only received cold brine, and lets the rest of the overflow pass back into the hot brine tank. This continues till the men in charge of the slabs find them to be sufficiently melted to be free from the cells to permit them to be lifted out. Then the donkey pump arrangements are reversed, and the cold brine is again pumped into the tanks containing the water cells, and communication with the circulating pumps is once more re-established, and freezing recommences. By this plan at least two tons of freezing brine are saved at each time of discharging slabs of ice from the cells. It will thus be seen that great care has been bestowed on the arrangement of the establishment we are describing.

There is yet another important feature to be noticed, and it is that which relates to the production of *clear* ice. It is known that free air exists in water, and it is necessary that as the ice crystallizes this should have an easy way of escape. An arrangement is, therefore, made by which zinc bars or stirrers are caused to dip into and agitate the water during the time it is being frozen. As the slabs freeze from the

outer surfaces, there is a central portion of the cell which remains liquid till nearly the completion of the process. Into this central part the agitator continues to move, till by the actual obstruction caused by the crystallization of the last portion, the agitating arm (which has only a falling motion due to its own weight, though it is mechanically *raised out* of the water) rests upon the top of the block, and the congealing of the mass then goes on without further mechanical help toward the removal of the air. The block of ice if froz n slowly enough is perfectly clear, but the more quickly the process is performed the less transparent is the ice.

Absence of air globules tends, of course, to the solidity of the ice and to its general toughness and power of resisting the melting effect of the atmospheric influence. Hence the necessity of a large establishment where, as in this case, ab ut 2 0 tons of water may be under operation at one time, and sufficient time be given to each and every block to freeze slowly, while the supply may be sufficient and so constant as to meet the requirements of the market.

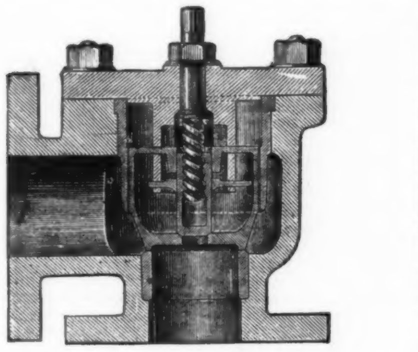
From recent inquiries made at these works we learn that the working of the whole machinery has be most satisfactory during the interval of 15 months since we first saw them at work. The consumption of fuel keeps at about the same rate as at the time of trial, viz., about 20 cwt. of coal for the production of 8 tons of ice. The daily (24 hours) produce is from 22 to 23 tons. The duplicated arrangement of pipes has worked very satisfactorily. The work has been nearly continuous throughout the past year, only having been reduced to 4 days per week during some periods of slack demand.

In warm weather, when the ice is of course most needed, the establishment works the full 6 days without stoppage, and its results are then still more perfect and complete, and the brine is more often kept down to 15° than 21° as given above. The cost of the water as used in these works is relatively greater than coal, and it therefore pays the company to use rather more coal and increase the power developed by the engines therefrom, in order to improve the vacuum of the ether pumps and produce a greater degree of cold thereby than they would if the circumstances were reversed, as might be t e case elsewhere.

We should here say that the whole of the water used for condensation and all other purposes, passes through the water meter, and has to be paid for. The result of the last financial year of the company has, we learn, been satisfactory for a first year, but it is expected to be much more so this year, as the works are now fully settled down into a regular system, and more storage room has been provided.

EQUILIBRIUM BLOW-OFF COCK.

THIS invention, by Mr. Booker, Manchester, Eng., has a valve inside the casement fitted very easy, which forms an annular space for the water to fill the casement, and a small valve and screwed nut combined with its seating on the center of the large valve, working on the screwed spindle which has a quick thread, so that about half a turn of the spindle will open full bore or close the outlet. The turning of the spindle raises the small valve from its seating, and



lets the water above the valve escape, thereby reducing the pressure, so that the water from the boiler forces the valve upwards and opens the outlet. By closing the small valve the operation is reversed. It is easy to work, not requiring more power to open a 3 inch cock with 100 lbs. pressure per square inch in the boiler, than it takes to open or close an ordinary ¾ inch plug tap, and is not liable to get out of order, there being no tight fits or stuffing boxes about the working parts, which are made of best gun metal.

LESSONS IN MECHANICAL DRAWING.

By Professor C. W. MACCORD.

Second Series—No. XI.

On the Screw Propeller. (*Continued.*)

IT was stated in the previous lessons that the acting surface of a "true screw" propeller is identical with that of the common square-threaded screw. We are aware that many, in looking at a propeller having two, three, or four blades, fail to perceive this identity. The reason probably lies in the great disparity between the conditions in the two cases. In the ordinary square-threaded screw, as commonly used in mechanical contrivances, the central core is large, the depth of the thread small, its thickness great, and the pitch fine; while in the propeller the core or hub is small, the thread very deep and thin, and the pitch coarse, by comparison. As nothing more facilitates the operation of drawing an object than a clear conception of the form and nature of the object itself, we shall introduce one more illustration, by the aid of which we hope that this matter will be made plain to any of our readers to whom it may not be so already.

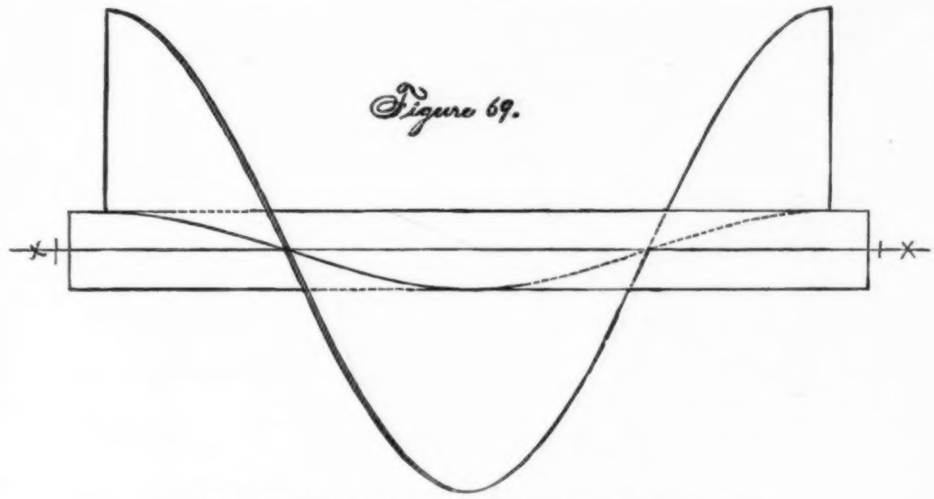
We illustrated the form of the square-threaded screw, by supposing it to be formed by winding a bar of flexible metal, of square transverse section, around a cylindrical core. Now, let us imagine this base to be made up of a great number of thin strips, placed side by side, and wound upon the core with their edges in contact with it; this will evidently form the square-threaded screw, as originally described. This done, we will then unwind all the strips but one; if the core be small, and the composite bar large, we shall now have left a very thin and deep screw-thread, as shown in Fig. 69. Next, we will cut away portions of this thread, so that the parts left shall appear as in Fig. 70, in the end view showing simply four sectors, seen in the side view as isolated pieces of the original thread. And finally, these detached pieces are to be moved along the central core until they are arranged as in Fig. 71, of which the end view is the same as in Fig. 70, but in the side view all the pieces of the thread are included between the same two planes perpendicular to the axis: and this is the four-bladed propeller, which, therefore, consists in fact of a short piece of a four-threaded screw; since it is evident that each of the blades in Fig. 71 might be extended, until it formed a complete screw-thread like the single one shown in Fig. 70. The number of blades, clearly, has nothing to do with their form; we may omit each alternate one, making a two-bladed screw, or we may use three, five or six or any other number; and it need hardly be said that the propeller may, like any other screw, be made either right-handed or left-handed at pleasure.

We selected as the first example the true screw, with the hub cylindrical, and limited by planes perpendicular to the axis, because of the forms in use this seems the one best adapted to the purpose of enabling the reader who may not have given attention to the matter, to form a clear physical conception of the nature of the surface and the form of the object to be represented. Supposing this purpose to have been attained, the simple form of the elementary blade which has been thus far discussed, is also a convenient starting point in entering upon the consideration of some of the many variations therefrom, which are likely to be met with. The first of these is in the form of the hub, which we have supposed to be cylindrical, as it often is; which form was selected, because the curve of intersection between it and the acting face of the blade is a helix. But the hub is very often not made cylindrical, for various reasons, among which may be mentioned the fact that if terminated as we have shown it by planes perpendicular to the axis, these blunt ends give undue resistance in the water; so that we will find the hub sometimes a part of a sphere, an ellipsoid, or a surface of revolution with some other outline. In Fig. 72 is shown one of the form first named; in the end view are shown parts of two blades, the complete number being four. These blades are supposed as before to be true helicoids without thickness, and the object of the diagram is to explain the method of determining the curves formed at their junction with the spherical hub.

This is really nothing more than a special case of a problem similar in its nature to those before explained. As before, the vertical center line in both the end and side views is supposed to coincide with the vertical element of the screw-blade; then drawing with any radius the arc *b d* in the end view, we set off on it from the center line aliquot parts of the circumference, as indicated by the points 1, 2, 3, etc., and draw radial lines through those points, which will be elements of the helicoid. Then setting off corresponding fractions of the pitch, from the center line in the side view, and drawing the vertical lines 1-2, 2-2, etc., we have the same elements as seen in that view.

These elements are perpendicular to the axis, and therefore lie in planes perpendicular to it, which, being seen edgewise in this side view, are represented by the same lines 1-1, 2-2, etc. But these planes cut the sphere in circles: thus the one through *e'* cuts out a great circle, which again cuts the vertical center line in *e* in the end view, showing that, as indeed is almost self-evident, *e'* is a point in the required curve. So also the plane through *a'* cuts the sphere in a circle whose diameter is *g' y'*, which circle is seen in full in the end view as *a m y*, and the left-hand edge or element of the blade is seen to intersect this circle in *a*, which, projected to *a'* on *g' y'*, gives that point in the curve. For intermediate points, we make use of the planes 1-1, 2-2, etc., thus the one through 6-6, in the side view, cuts a circle from the sphere, the extremity of whose radius is *o*; this is most conveniently projected to *p* in the end view, and the circle through *p* about the center of the sphere cuts the radius 6-6 in *r*, which is projected back to *r'* on the vertical line 6-6 in the side view. So also *i*, projected to *n*, revolved to *t*, and counter-projected to *u*, gives another point in the side view of the required intersection, *a' r' u' e'*, which is one half, and being concealed by the hub, it is dotted; the other half, *e' c'*, is perfectly symmetrical with it, and is visible, the hub on the right-hand side being concealed by the blade.

On the right-hand side in the end view we have shown a portion of the second blade, the side view of which would be identical with a top view of the first blade, since the one is vertical and the other horizontal.



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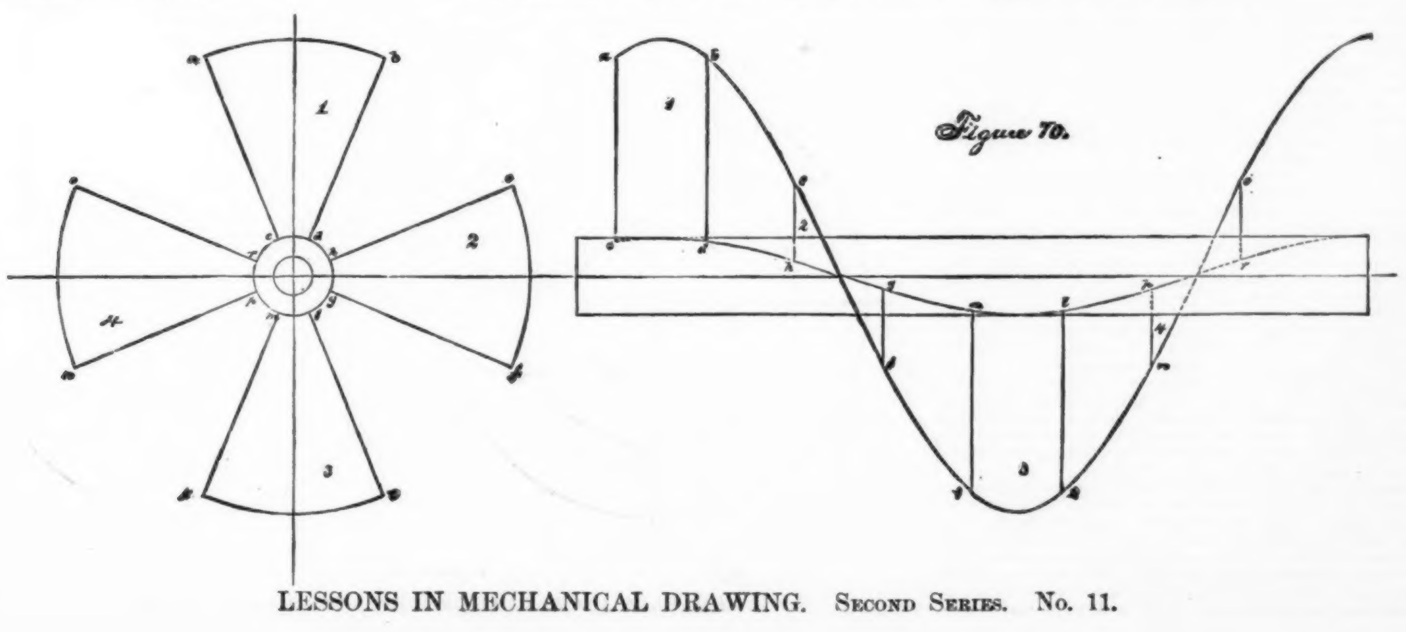

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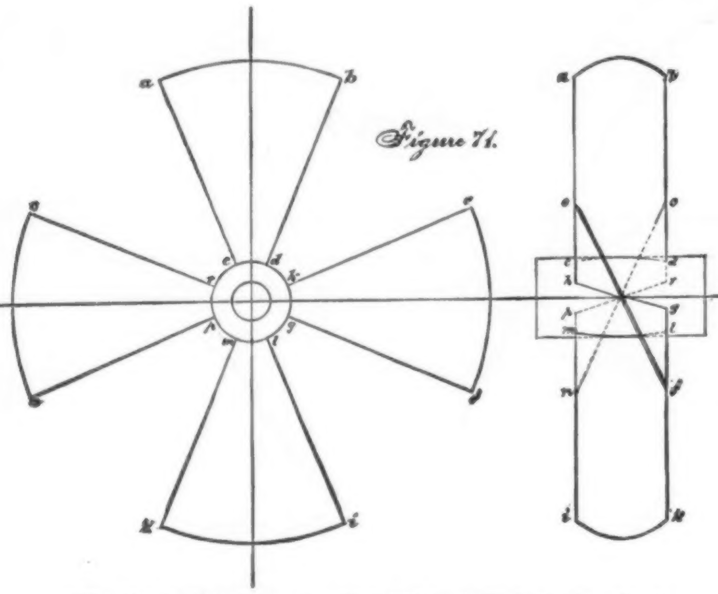
That is to say, if the propeller be turned a quarter round toward the right, the first blade will become horizontal as the second now is; the curve $m\,x\,z$ is consequently a mere copy of $a\,c\,c$, and the radial lines 4–4, 6–6, intersect $m\,x\,z$ in points v, s, corresponding to t and r after a quarter of a revolution. But they still lie in the same planes perpendicular to the axis, and the same is true of all the other points; therefore we project m to m' on $y'\,y$, s to s' on the vertical line 6–6, v to v' on 4–4, and so on in order until we have the complete curve $m'\,x'\,z'$, which is the same as a top view of $a'\,c'\,c'$.

A similar process will, it is clear, enable us to draw correctly the curve at the junction of the blade with any hub which has the form of a surface of revolution concentric with the shaft, whatever the outline.

Next, it is to be observed that the sides of the blades are not necessarily included between planes perpendicular to the axis. Any part of the entire screw-thread of Fig. 69 may be used; and a form of the true-screw propeller has been very extensively used, in which the blades, instead of appearing plumb or perpendicular to the shaft, in the side view, as in Fig. 71, pitch backward, or overhang the hub, as shown by $l'\,h'\,i'\,m'$, Fig. 73. This figure, we have now



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to explain, does not represent the blade correctly; it is an incorrect drawing, which we have introduced, because it illustrates the manner in which a working drawing of the propeller is very often laid out, and having described it, we shall next proceed to make a correct drawing of the same propeller, that the reader may see more clearly the difference between the true and the false.

Having drawn the side and end views of the hub, and the circle indicating the outline of the screw, the too common practice is to proceed as follows.

Through c', the center of the side view of the hub, is drawn a vertical center line; the c' thus corresponds to the line $c\,f$ in the end view, and $k'\,g'$ corresponds to $k\,g$; these are the projections of two elements, one of the horizontal, the other of the vertical, blade. The projections of the inner and the outer helices of the horizontal blade will also pass through c' in the side view; we have seen that, this being the point of contrary flexure, these projections will, for some distance on each side of c', appear nearly straight; in the method under consideration they are assumed to be quite straight, and their directions are thus determined. From c' lay off on the horizontal $c'\,v$, equal to the pitch of the screw as measured on any convenient scale; at v erect a perpendicular, on which set off, by the same scale, $v\,w$ equal to the circumference of the hub, and $v\,x$ equal to that of the rim of the propeller, and draw $c'\,w$, $c'\,x$. These lines, the reader will at once perceive, are the developments of the two helices, and would be tangent at c' to the projections of those curves if actually drawn.

The points d', e', are determined by the intersection of $w\,c'$ with the ends of the hub; but instead of producing these ends to limit the outer helix, as in Fig. 71, the distance $c'\,b'$ is made less, and the distance $c'\,a'$ greater, than if that were done, thus causing the blade to overhang the hub on the after end. Now, since $a'\,d'$, $b'\,e'$, would have been straight, had the blade, as at first, been limited by planes perpendicular to the axis, it is assumed that they will be straight now, and they are drawn so. In the end view, d' and e' are projected to the circle of the hub d and e, a' and b' to a and b on that of the rim, and the drawing of the blade completed by the straight lines $a\,d$, $b\,e$.

Naturally, and correctly enough, too, the side view of the vertical blade is constructed by the aid of the end view, which is simply a copy of that of the horizontal one just drawn; h, i, corresponding to a and b, and l, m, to d and e, with reference to the lines $g\,k$, $c\,f$. These points are counter-projected to h', i', l', m', in the side view, after which the same assumption is made that $h'\,l'$, $i'\,m'$, are straight, and the helical arcs $h'\,g'\,i'$, $l'\,k'\,m'$, complete the side view. Finally, since h' will go to n, l' to p, m' to r, and i' to o, as the screw turns round, it is assumed that the space required to permit free revolution will be of the outline bounded by the ends of the hub and the straight lines $p\,n$, $r\,o$, $n\,o$.

This has reference to an elementary overhanging blade, without thickness. We have not introduced the rounding of the corners, which is ordinarily done in practice with about as many erroneous assumptions as are already involved, because we do not consider it necessary to complicate the diagram with any more of them.

Now, if a drawing like Fig. 73 be put into the hands of an experienced moulder, he will make the propeller, because he learns from it what he is to make. That information, indeed, might be given him without any drawing at all, thus: tell him that he is to make a four-bladed true screw, of a given pitch, diameter, and size of hub, the latter to be cylindrical; that the point of the leading edge (b in the figure) is to overhang the forward end of the hub by a certain distance ($c'\,w$), and the point of the trailing edge (a') is to overhang the after end of the hub by a certain other distance ($d'\,y$).

A knowledge of these conditions enables the expert to comply with them, without any reference to the drawing. But when the propeller is made, it will not look like the drawing given in Fig. 73, which, although it contains accurate information as to the conditions, also contains a very inaccurate representation of the results obtained by complying with them. It is needless to say that this ought not to satisfy the conscientious draughtsman, even though the propeller turns out all right when made. If calculations and comparisons are to be made by the aid of the drawing, their results may be sadly vitiated by the inaccuracies introduced; and besides, if the draughtsman cannot draw the true screw correctly, he will probably be still more at a loss if called on to draw a propeller of increasing pitch, in which case, too, the errors of the drawing may seriously impair the correctness of the screw itself. We therefore proceed to reconstruct this drawing, so as to represent accurately the propeller which will comply with the conditions above specified: though first it may be as well to explain the terms "leading" and "trailing," above used. The reader will see by a little study, that in order to drive the vessel ahead, in the direction of the arrow in the side view, this screw must turn in the direction indicated by the curved arrow in the end view, which latter represents the screw as seen from the aft side: $b\,e$, then, is the entering or "leading" edge, and $a\,d$ the following or "trailing" edge of the horizontal blade.

The correct drawing of this elementary blade is given in Fig. 74. The points d' and e' are determined by drawing through c' the helix on the surface of the hub, and will therefore coincide very nearly with the corresponding points in Fig. 73, the curvature being very slight: and these are projected to d and e, on the circle of the hub in the end view. We next draw the outer helix through c', and its limits a' and b' are easily found, the distances $d'\,y$, $e'\,u$, fixing the amount of overhang; after which a', b', are projected to a, b, on the circle of the rim.

Now, in determining the lines $a\,d$, $b\,e$, $a'\,d'$, $b'\,e'$, three courses are open to us. We may assume $a\,d$ to be straight; and if we do, since the points on the blade, which appear in that line in the end view, are at different distances from us, it follows that $a\,d$ itself must represent a plane seen edge wise, whose intersection with the surface of the blade we should then have to determine in order to find the form of the lines $a'\,d'$, $h'\,l'$, erroneously assumed in Fig. 73 to be straight: and after that we must ascertain the form of the outline $n\,p$, swept out by $a'\,d'$ or $h'\,l'$ in revolving. Or we may assume $a'\,d'$ to be a straight line, in which case, by similar reasoning, we see that it will represent a plane seen edgewise in the side view, cutting the screw-blade in lines whose projections $a\,d$, $h'\,l'$, are yet to be found in the end and side views, after which $n\,p$ must be found as before. Or, finally, we may assume $n\,p$, and from it determine the projections $h'\,l'$, $a'\,d'$, $a\,d$, of the line on the helicoidal blade, which, in revolving, will sweep out the outline $n\,p$. The last is the course usually adopted, because, as explained in the previous lesson, it at once enables the designer to plan the surroundings.

We have already seen that a' will go to n, and l' to p, in the course of the revolution: we will, therefore, assume $n\,p$ to be a right line. And on the leading edge, b' will eventually go to o, and e' to r; we will then in like manner assume $r\,o$ to be straight, and drawing $n\,o$, we have the complete outline of the space within which the propeller is to turn. From this we can ascertain the form of the blade in substantially the same manner as that in which the effect of rounding off the corner of this space was found, as explained in the preceding lesson.

Beginning with the left-hand or trailing edge, the readiest mode of proceeding is to set off from a on the circle of the rim in the end view small aliquot parts of the circumference, through which are drawn the radial lines 1–1, 2–2, etc. These radii represent the right-line elements of the blade, and appear in the side view as the vertical lines 1–1, 2–2, etc., spaced off from a', and separated by distances which are corresponding fractions of the pitch. Or if such radial and vertical lines have been already drawn in constructing the helices $a'\,b'$, $d'\,e'$, they may be made use of, intermediate ones being introduced if they be too far apart.

These auxiliary lines are used in a manner precisely similar to that before described. Thus in the case in hand, the line $n\,p$ cuts the auxiliary vertical 1–1 in the point s, which is by hypothesis the highest position to be occupied in the revolution, by the point on the blade whose actual position in the drawing is on the element of the surface represented by that vertical center line in the side view and by the corresponding radius 1–1 in the end view. We therefore project s to t, on the vertical center line in the end view, with the T-square, as the readiest mode of obtaining the radius $C\,t$; with this radius we set off $C\,v$ on the radius 1–1, and counter-project v to v' on the vertical line 1–1, which determines a point in the required curve in the side view.

We have indicated the equality of $C\,v$ and $C\,t$, in the diagram, by dotting the circle about C through v and t: but the reader must not forget the protests repeatedly made against making pencil lines needlessly, only to be erased, and will at once see that he need not *draw* this arc, but may simply set his compasses to the radius and mark the point v. Since all the blades are exactly alike, it is to be noted that much time may be saved by constructing the lines $a'\,v'\,d'$, $a\,v\,d$, $h'\,u'\,l'$, $h\,u\,l$, simultaneously, which may be done, thus: As soon as a and b, d and e, have been located as above explained, set off $g\,h = c\,a$, $g\,i = c\,b$, $k\,l = f\,d$, $k\,m = f\,e$. Then from h set off the same spaces that were set off from a, on the rim, and draw a similar series of radii through the points of division. These are the end views of the right-line elements of the vertical blade, and their side views are the same vertical lines 1–1, 2–2, etc., that we have already drawn.

Consequently, at the same time that we mark the point v on the radius 1–1 of the horizontal blade, we may mark the point u on the corresponding radius of the vertical one, and counter-project these points with the T-square to u' and v' on the vertical 2–2 in the side view. By thus proceeding systematically, this construction, which appears at first sight rather a tedious problem, and really may be made such by a judicious irregularity in its execution, can be performed with great ease and rapidity.

It will also be seen that had the corners been rounded off, as in Fig. 68, the difficulty of drawing the screw would not

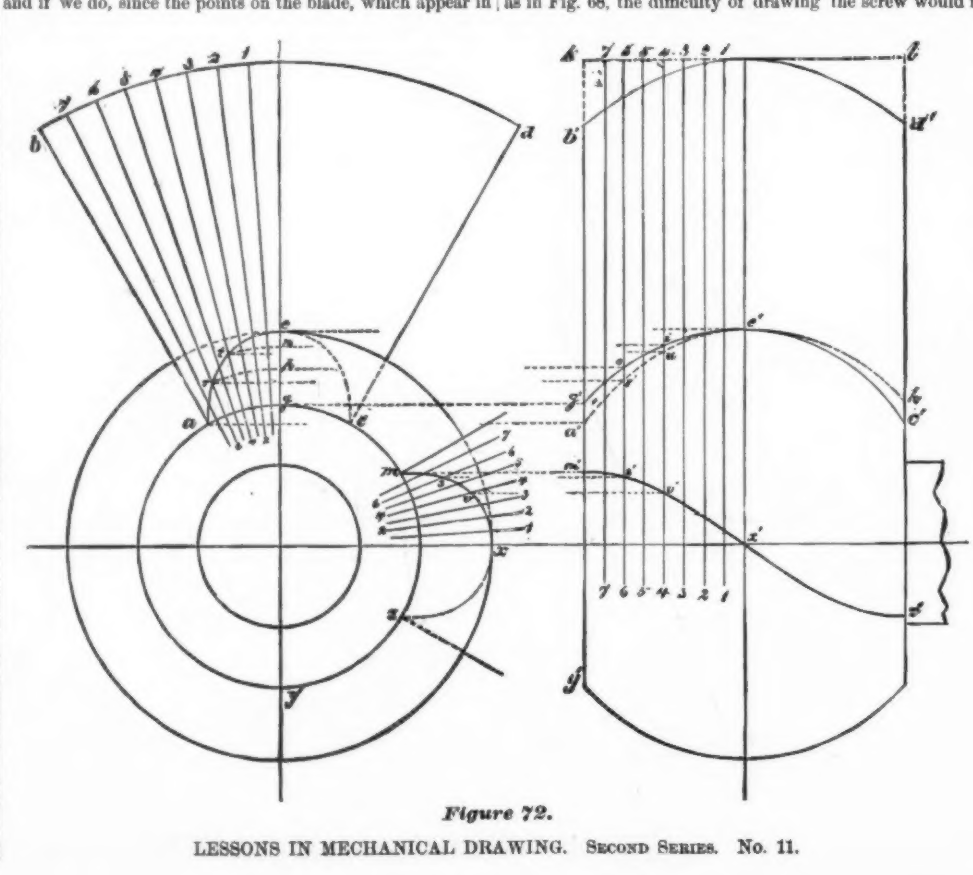


Figure 72.

LESSONS IN MECHANICAL DRAWING. SECOND SERIES. No. 11.

have been increased to any extent worth mentioning; and the reader is advised to introduce that condition in making his construction.

The process of finding the form of the leading edge is precisely the same, and therefore requires no more words; in the diagram the lines used in finding one of the points in the four views are introduced, by the aid of which the reader who has followed the preceding will be able to trace the operation.

The difference between the true and the false diagrams is, we take it, sufficiently marked to show that the labor involved in making the former is by no means great enough to warrant any one in resting content with the latter. This difference is due wholly, as the reader will perceive, to the false assumption that, because two points are joined by a right-line element of the screw surface under certain conditions, corresponding points will also be joined by right lines under other conditions. The result is not so outrageous in the side view, but in the end view, which is of much importance as showing the proportion of the whole area of the disc of the propeller occupied by the acting surface, as well as the distribution of that surface with regard to the axis, the idea conveyed by the false construction is very wide of the mark. Were the approximation very close, and the difference in labor very great, even, the intrinsic interest attaching to the problem ought to repay one for making the construction on correct principles; as it is, the not doing so is wholly inexcusable.

Thus far we have confined our attention wholly to the acting surface of the screw—the blade being supposed to be without sensible thickness: which being impossible in practice, we shall in our next lesson introduce that consideration, giving the necessary substance to enable the blade to do its work, and thus making the drawing complete in all respects. This will be found to modify the appearance very materially: beside which, the difficulty of making the drawing, either on the true or the false basis herein discussed, will be found considerably greater. We mention this in order to give the student fair warning that it is necessary for him to familiarize himself with the principles and methods already explained, in order to make satisfactory progress with what will follow. And as we have repeatedly stated, this can be done surely and thoroughly in no other way than by actual practice: in respect to which we wish, finally, to impress upon the reader that complicated constructions of this sort are much more satisfactory, and not only that, but of much greater value as exercises, if made upon a comparative large scale. Our diagrams are for obvious reasons made as small as is consistent with perfect distinctness, and the drawings ought to be made at least two or three times as large.

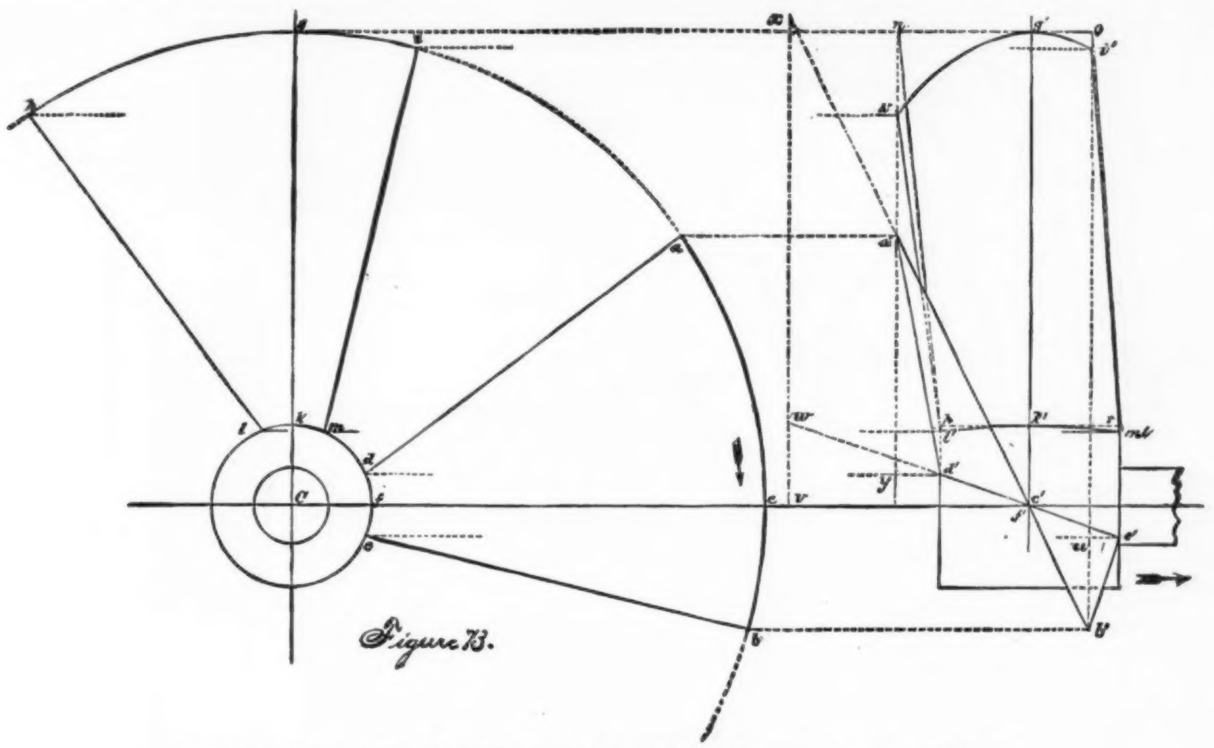


Figure 73.

LESSONS IN MECHANICAL DRAWING. SECOND SERIES. No. 11.

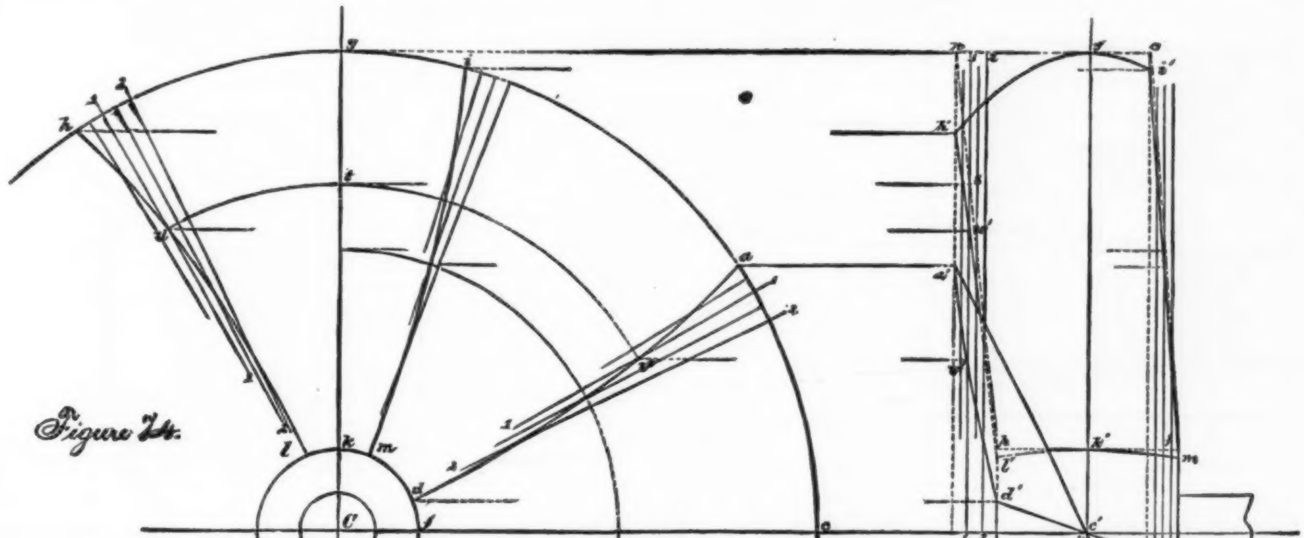


Figure 74.

LESSONS IN MECHANICAL DRAWING. SECOND SERIES. No. 11.

STREET TRACK SWEEPER.

WE give an engraving of a sweeping machine for sweeping snow from railroad tracks, designed and constructed by E. A. F. Olmstead.

The sweeping mechanism consists of two cylindrical brooms 44 in. in diameter, arranged diagonally under the body of the sweeper. These brooms are made of rattan, and they are geared from bevel wheels with 25 teeth on the axles to other similar wheels with 13 teeth on the broom shaft, so that the brooms make very nearly two revolutions to one of the axle. They will sweep 7 feet wide, and remove snow 15 in. deep when running at a speed of 20 miles per hour.

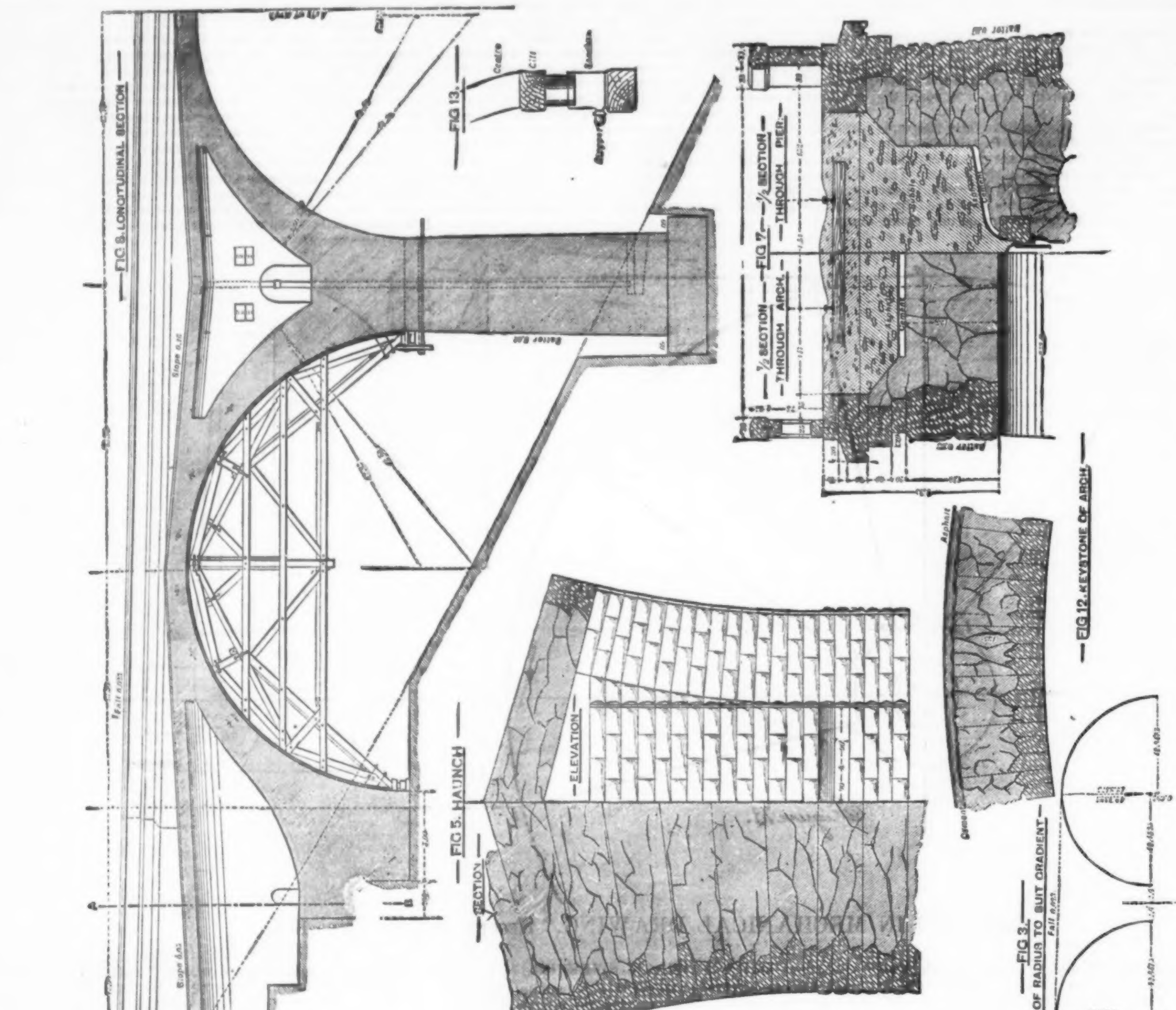
The whole machine is 21 ft. long and 6 ft. 4 in. wide. The wheels which carry it are 42 in. in diameter. The brooms can be raised and lowered, and thus adjusted to the track, by means of rods, one of which is attached at each end of the broom shaft, and is operated with a screw and can be raised and lowered in a moment.

PRESERVATION OF IRON STRUCTURES.

By C. GRAHAM SMITH.

THE paints used for ironwork are of every description, name, and quality. The usual varieties employed for preserving it against corrosion may be divided into lead, iron oxide, silicate, and tar paints. Differences of opinion exist as to the relative merits of the first three descriptions, but the experience of several foremen painters connected with establishments in England, is decidedly in favor of lead paints when of good quality and mixed with good oil without spirits. Unfortunately there are no reliable practical tests to insure good materials alone being used; consequently both the colors and the oils are often inferior in quality, and much adulterated. For these reasons and on account of cheapness, iron oxide paints are by some preferred.

A little white lead mixed with red makes it go farther, and easier to work into corners. If the first coats are put on with pure red lead, owing to its weight it is liable to run off; but the last coat should consist of red lead alone. The tar paints are more often used for ironwork which is not to be seen, such as water pipes, floor plates of bridges, and girders which are to be built into masonry or brickwork. It is cheap, and answers well for such purposes and for sea work, as it is said not to foul so readily as lead or other paints of a finer description. A good rough paint is made by heating coal tar, and mixing with it finely sifted slaked lime, in the proportion of between half a pound and a pound of lime to a gallon of tar, adding sufficient naphtha to render it of a convenient consistency for laying on. This composition should be applied while hot, but not too hot. Do not keep it over the fire too long, or it will lose its essential oils. Some positions admit of the paint being sanded, in which case it should be done, as it adds to its durability. Before painting iron, give it a coat of boiled linseed oil applied hot.



THE ROUCHAT VIADUCT ON THE PARIS AND ORLEANS RAILWAY.

THE ROUCHAT VIADUCT.

The Rouchat Viaduct in the neighborhood of Vignoles, France, consisting of eight openings of 25m. span and a maximum height of 55 metres, is constructed for a single line of rails, and crosses a gorge about 1 kilometre above the main valley in a straight line, with a gradient of 23 per cent., or about 1 in 43½. The general plan and elevation are shown in Figs. 1 and 2.

The springing courses are horizontal over each pier, and the gradient obtained with as slight a distortion of the façade as possible by dividing the arch into two quadrants with different radii starting from the center, as shown in Fig. 3. The foundations in every case was carried down to the rock. The quarries from which the materials were obtained being situated at some distance towards the main valley, necessitated the use of a temporary tram road and a wire rope railway worked by a steam whin. Coursed rubble masonry was adopted throughout, with the exception of the foundations below ground-line and of the haunches. The face stones are about 20 c.m. (8 inches) deep, in Fig. 5. In the backing, small irregular rubble stone, sometimes less than 8 cube decimetres—about ¼ cube foot—were used, but set in perfect bond with great care. The courses were leveled over every second or third, as shown in Figs. 5, 6, and 7.

The centering, on account of the height of the piers, was supported by iron rails (see Fig. 8), two of which were so built into the masonry side by side that they could, after the arches were completed, easily be removed. When the haunches had been carried up about two metres above the rails the centers were set, and each span loaded with about twenty cube metres of stone, which was afterwards worked into the arch as the masonry proceeded. The scaffolding was of the lightest description, as no heavy stones were used, and consequently traveling cranes, etc., were not required. On the face of the center, laths were fixed radially, to facilitate leveling off the courses of the arches, in which the masonry differed from that in the piers, in that the courses were radial instead of horizontal.

The usual distinction between arch and backing was not made, the courses in the haunches running back to the center of the pier, so that the vertical projections of all the joints were nearly the same, and the arches considerably strengthened at the springing.

The face stones of the arches were of the same depth as

FIG 1.

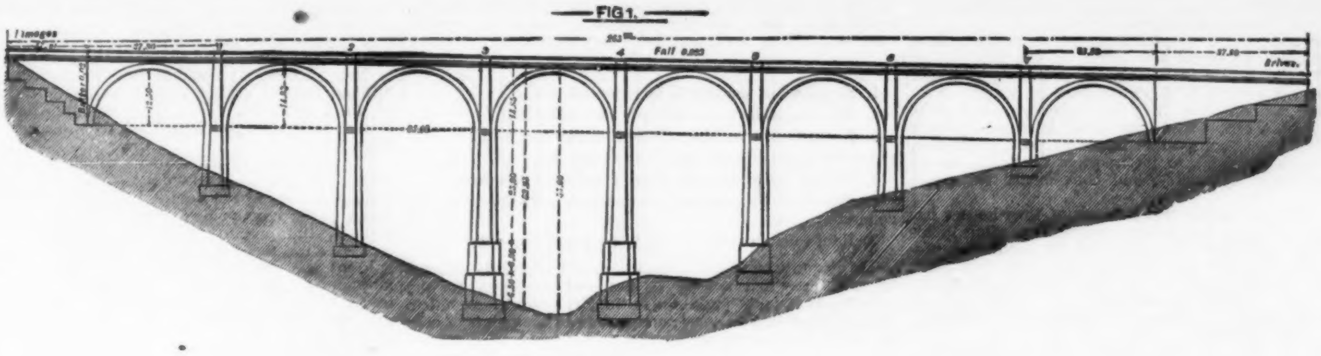
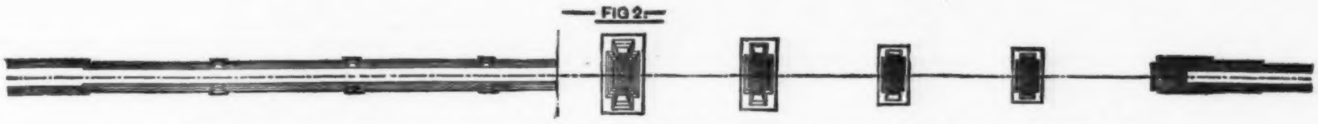


FIG 2.



THE ROUCHAT VIADUCT ON THE PARIS AND ORLEANS RAILWAY.

the keystones, and so bonded with the principal masonry that the whole was equally affected when the centers were struck. The usual sandboxes in general use in France, as shown in Fig. 13, were employed for lowering the centers. The arches were keyed with three, or at most four, courses of face stones, and the upper part filled in with large stones carefully wedged from above, as shown in Fig. 12. Iron tie rods, as shown in Fig. 8, were used in the spandrils and arches to hold the masonry until thoroughly set. As is customary in France, the piers are relieved of as much unnecessary weight as possible by the introduction of arching wherever practicable, as shown in Figs. 8, 10, and 11, whereby a considerable expenditure of masonry is saved, a large weight taken off the piers, and the drying of the masonry expedited. In addition to this, easy access is obtained for examination of arches, piers, and abutments, by the introduction of shafts with ladders from above, as shown in Fig. 10. The arches in the abutments are approachable from openings in the side, constructed to act as drains as well, as shown in Figs. 8 and 11. All these openings are fitted with iron doors. The arches and spandrils are covered with about 10 c.m. of cement and a layer of asphalte reaching about 2 c.m. up the side walls, where it is replaced by coal tar—see Figs. 7 and 12.

The arch drains are constructed, as shown in Fig. 7, with dressed stone hoppers, with an inside casting of cast iron, with a filter cover fitting into the gas piping which runs down the center of the piers and discharges itself into a small arched drain. The disadvantage of these pipes is that they are difficult of access and very liable to get choked during construction. The intermediate spaces between the asphalte and formation level are filled up with clean dry rubble.

The work was executed under the management of M. Morandière, who is actually the introducer of this rather unusual system of construction.—*The Engineer.*

CHEAP FIRE-PROOF HOUSES.

DESCRIPTION OF MODEL FIRE-PROOF HOUSES ERECTED FOR MR. SYDNEY MYERS, ON SACRAMENTO AVENUE, CHICAGO.

Foundations.—Stone, laid in concrete.

Walls.—Brick; 14 inches thick in lower story, 10 inches thick above, built with a 2 inch hollow space, but made solid and corbelled out at each story to receive beams.

Beams and Rafters.—Of wood.

Smoke-Flues.—Lined with pipe of burnt clay.

Ceilings.—Concreted one and one-half inches thick below floor-beams.

Floors.—Smoothed boards on beams, stripped with beveled strips one and one-quarter inches sloping to five-eighths wide, one and one-half inches thick; filled with concrete between strips; and covered with good pine flooring-boards.

Roofs.—Smooth boards nailed on rafters; strips same as for floors; concrete between strips one and one-half inches thick, then covered with flooring-boards, and over all tinned and painted.

Walls.—Best three-coat work and hard finish; plaster laid on the brick without lath or furring.

Drainage.—Drain-pipes under basement-floors both to the front and rear.

Water.—City water has been introduced, and there is a bath-tub in second story, and sinks in kitchen and laundry.

Steps.—The front steps are of Lemont marble; back steps of brick stuccoed with Portland cement. All stairs inside are built of brick, and covered with Portland cement, and prepared to receive carpets. Grates and marble mantel-pieces in front parlors.

Walks.—The sidewalks are of Portland cement; walks in backyards of plank.

Fences.—Of planed boards, painted with fire-proof paint. Park fences in front to protect trees and grass.

Yards.—All nearly graded and sodded.

Paint.—Parti-colored, inside and outside.

Cornices.—Cornices of brick, laid with projections, and painted to contrast with face of walls.

Partitions.—All partitions are either of Loring's terra-cotta brick (about two-thirds the weight of Chicago brick), or of concrete laid up in supports of telegraph wire.

Anchors.—All walls are thoroughly anchored, and hollow brick walls tied with wrought iron anchors one-half inch wide and one-fourth inch thick, set every five courses, and three feet apart horizontally.

Concrete.—All the concrete used for ceilings, roofs, floors, and partitions is composed of one-half cinders, one-fourth mortar, and one-fourth plaster of Paris.

All the ceilings in the Sacramento street houses are made on James John's patent, and supported from No. 17 galvanized iron wire, attached to tenpenny nails driven into the beams four inches apart.

Specimens of ceilings supported on beveled strips and split lath have been tested, and are found to resist fire. The cost of John's ceiling, including hard finish, is from seventy to eighty cents per square yard. The substitute costs about forty cents per square yard, and is given to the free use of the public. Floor and roof concreting costs about twenty cents per square yard.

Cost.—Four small houses of substantially the same construction have been erected near the Northwestern Car Shops, northwest of Central Park, two stories high, tin and concrete roofs, with lots neatly graded, fenced, and sodded, with cisterns, etc., and offered for sale for $1,800—$500 cash, and the remainder in easy payments extending through five years or more.

The houses on Sacramento avenue are offered for sale for $3,500 each, including the lots and appurtenances—$750 cash, and balance on easy payments. One-half may remain on mortgage as long as desired, if interest is promptly paid.

Location.—The location of all these buildings is on high ground, within ten or fifteen minutes' walk of the West Side Parks, a very considerable portion of which are improved with walks, drives, ponds with boats, fountains, etc.

Mr. A. J. Smith, architect, 77 Clark street, was the successful competitor for the prize of $1,000; and these buildings were all erected under his immediate supervision and upon the mode of construction contained in his specifications.

Mr. Thomas R. Jackson, architect, of No. 257 Broadway, New York, has been the consulting architect, and was employed to visit the principal Eastern cities, and decide upon the possibilities before the prize was offered, and aided the Committee of Award in analyzing and compiling the information and suggestions in the thirty plans and specifications submitted in competition for the price of $1,000.

Objects in View.—To secure an approximately fire-proof building within easy financial reach of all industrious and frugal people, and thereby to demonstrate the practicability of rendering all new buildings practically fire-proof at reasonable cost. The *percentage* of additional cost is, of course, greater on small buildings than on larger and more pretentious ones as to size and finish; but it is the opinion of both architects that well-protected smoke-flues, hollow walls, and concreted roofs, floors, and ceilings, can be secured in the erection of the *average* dwelling at not exceeding eight per cent additional cost over the cost of an honestly constructed building with brick walls, but with inflammable roof, and unprotected beams and rafters.

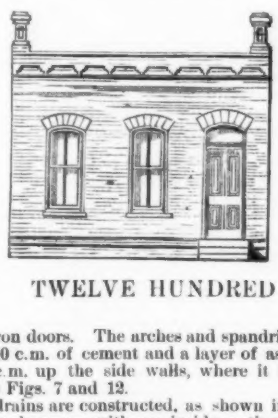
Results.—If the results of these efforts to prevent great conflagrations by eliciting practical suggestions for the more substantial building of cities and towns shall be in a moderate degree successful, the originators of this special enterprise will feel fully repaid for some expenditure of time and means.

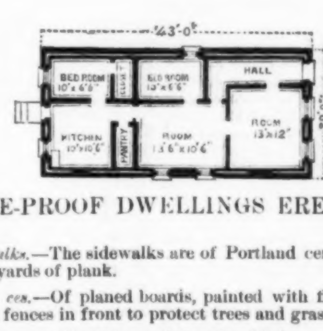
REPORT OF THE EXPERT COMMITTEE ON AWARDS.

CHICAGO, Aug. 16, 1875.

SYDNEY MEYERS, Esq., *Manager Merchants', Farmers', and Mechanics' Savings Bank:*

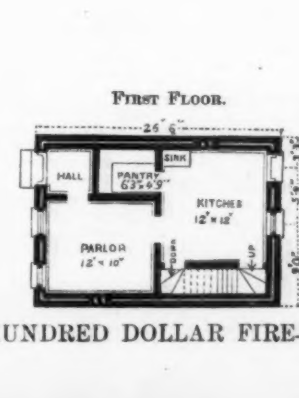
DEAR SIR—The undersigned, your committee appointed to examine the plans and specifications submitted in com



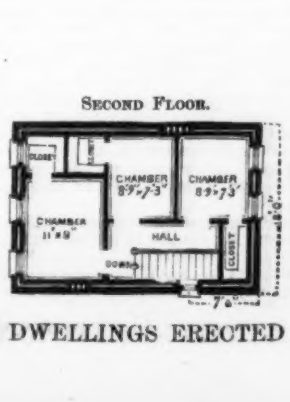


TWELVE HUNDRED DOLLAR FIRE-PROOF DWELLINGS ERECTED IN CHICAGO. PRIZE PLAN No. 1.

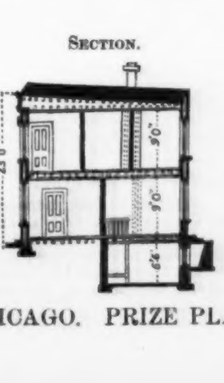
FIRST FLOOR.



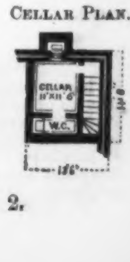
SECOND FLOOR.



SECTION.



CELLAR PLAN.



SEVENTEEN HUNDRED DOLLAR FIRE-PROOF DWELLINGS ERECTED IN CHICAGO. PRIZE PLAN No. 2.

petition for the prize of one thousand dollars ($1,000), offered by you for the best plans for an approximately fire-proof dwelling, beg to report as follows.

After a thorough and complete examination of the various plans submitted, the award was made on the first day of February, 1875, to Mr. A. J. Smith, architect, Chicago, conditioned upon the faithful performance on his part of all the stipulations contained in your circular, involving the erection by him of a house constructed substantially upon plan submitted, said house to be tested by your committee, especially with reference to its fire-proof qualities; but its cost, construction, symmetry, and convenience to be also considered.

Having received notice that a block of four houses has been constructed on Sacramento avenue, according to his specifications, under the supervision of Mr. Smith, we proceeded to the locality Saturday afternoon, the 14th inst., where we found the south one of the block furnished for occupancy, and exceedingly desirable as to capacity, neatness, and symmetry, as well as in respect to substantial qualities in the construction.

These houses have two stories and basement; stone front steps, and steps to basement; hollow brick walls; Portland cement stairs inside, supported on brick, and the same description of steps to the yard, both from the principal floor and from the basement; all partitions are of brick or concrete, and all timbers perfectly protected with the same materials; roofs covered with concrete, and then tinned and painted; all smoke-flues are lined throughout with burnt clay-pipe; the window-sills are of stone; and the window-caps of terra-cotta.

The houses are complete in all their details, with trees and grass in front enclosure, and sidewalk of Portland cement, and within everything ready in order for housekeeping, including gas and water pipes, sinks, bath-tubs, etc.; the yard, with neat, painted fences, and sodded, having all necessary appurtenances, even to hooks ready for the clothes-line; and, as the cost is an important element in such experiments, we will add that the houses and lots are being sold for three thousand dollars ($3,000) each. Terms, one-fourth cash, and the remainder in easy payments. These houses cost, without the appurtenances, about $2,000 each.

We then proceeded to the north house, which was in an unfinished state, ready for the test. This building contained representative furniture, made of pine, equivalent to that in the furnished house, besides which the floors were thickly strewn with shavings; and, the further to facilitate a rapid and intense heat, the windows were left open, furnishing a perfect draught of air through the building.

The fire was started at five o'clock; and, after it had nearly burned itself out, water was introduced by Fire Marshal Benner, and thrown against the walls and ceilings from an engine, to ascertain the effect of water thrown on the material when heated.

The result of this test was most gratifying to your committee, satisfying them that the building was, indeed, all that had been claimed for it, and entitling Mr. Smith to the full benefit and award.

The only damage we were able to discover as the result of the test consisted in the falling of some of the rough coat of mortar, the partial burning of the window-casings, and discoloring of the window-caps by smoke.

In addition to the test made to the building itself, we also tested two sectional buildings, intended to show more particularly the construction of the roof and ceiling, of which there were two kinds—one known as John's patent ceiling, with wires stretched at intervals of four inches to form the support of the whole mass of mortar and concrete; while the other, an arrangement of your own, in which the support for the mortar was formed by nailing wood lath to beveled strips of wood on the under side of the joists, so that, when the concrete is filled in on top, it forms a self-supporting arch.

Both these sections were subjected to an intense heat for three-fourths of an hour, when water was applied, and they were found to be in apparently as good condition as before the test.

In conclusion, we repeat that the test was in every manner satisfactory to us as fully conforming to the requirements contained in your circular.

We cannot close this report without expressing our appreciation of the great work you have accomplished in demonstrating not only to Chicago, but to the whole country, that good, pleasant, and indestructible houses can be constructed at a moderate cost, and we hope soon to see them replace the unsightly, unhealthy, and unsafe buildings so much in use at this time.

Very respectfully yours,

LOUIS WAHL, *Representing Board of Public Works*, (per REDMOND PRINDIVILLE, *Pres't Board of Public Works*).
CHAS. W. DREW, *Representing the Chicago Board of Underwriters.*
N. S. BOUTON, *Representing the Citizens' Association.*
BEN. C. MILLER, *Representing the Board of Health of Chicago.*
AMOS GRANNIS, *Representing Builders.*

SUPPLEMENTARY REPORT.

CHICAGO, Aug. 16, 1875.

We, the undersigned, were present at the fire-test described in the foregoing report of the awarding committee, and, having carefully examined the buildings described, take great pleasure in adding our testimony as to the correctness of the facts stated in the report, and desire to signify our concurrence in the same, and our high appreciation of the useful results of these efforts to bring substantial homes within the reach of all classes of our people, and the introduction of a method of building, which, if generally practised, will soon render our towns and cities exempt from great conflagrations, and, by reason of securing safer investments, bring more capital to our cities for investment for the benefit of *all* classes.

H. D. COLVIN, *Mayor.*
R. PRINDIVILLE.
J. K. THOMPSON, *Board of Public Works.*
M. B. BAILEY, *Inspector of Buildings.*
M. BENNER, *Fire Marshal.*

NOTICE.—M. F. AND F. SAVINGS BANK.

This institution is now prepared to loan money for the erection of buildings within the limits of the city of Chicago. Preference will be given to depositors. Applications will only be entertained from those who have unencumbered lots of satisfactory value, on which they propose to erect buildings; and the money will be advanced as the buildings progress.

The construction recommended is illustrated in the model houses on Sacramento avenue, which have been thoroughly tested as to their fire-proof qualities, and in the special models of ceiling, roof, and floors near the same.

CONSTRUCTION RECOMMENDED.

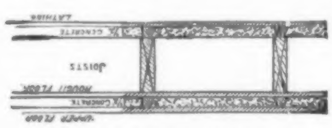
1. Fire laws of the city to be complied with.
2. Exterior walls to be hollow "between joists."
3. No furring or lathing allowed on exterior walls.
4. Flue-pipes of soft burnt clay to be used.
5. Ceilings to be covered with 1½ inches of concrete.
6. Floors to be protected underneath with 1½ inches of concrete.
7. Roof to be protected with 1½ inches of concrete.

This bank has adopted a rule which will be strictly adhered to in future—that none of its funds will be loaned for the erection of the new buildings in the city of Chicago, unless at least the *first, fifth, sixth,* and *seventh* of the points of construction above given are applied.

SYDNEY MYERS, *Manager.*

CHICAGO, Aug. 16, 1875.

[Of course, the most important point in this system of fire-proof work is the method of rendering a construction of common floor joists or rafters practically incombustible. The annexed diagram will sufficiently explain the contrivance adopted. The roofs are treated in the same manner.



SECTION OF FIREPROOF FLOOR.

The concrete is made as follows: ⅓ common cinders from rolling mills, screened; ⅓ mortar; ⅓ plaster of Paris; mixed to the consistency of *mush*, poured in buckets on the rough flooring or laths, and tempered down with hose: this composition, it is said, will dry in twenty-four hours, "forming a hard, dry, white stone."—Ed.]—*American Architect and Building News.*

PRICES NOW AND IN 1860.

IN a careful article elicited by the railway strikes, the New York *Tribune* lately gave the following comparison, based, it is stated, on the wholesale prices of over sixty articles, including different forms of breadstuffs, coal, cotton, wool, iron, leather, tobacco, butter, cheese, sugar, molasses, coffee, tea, and various forms of provisions, averaged according to the proportions of different articles sold. The first column shows the sum which would be required to purchase each year the same quantities, while the second column shows the proportion of each year's average price to that of 1860, taken as a standard, or 100. The dates taken are May 1 each year, excepting 1877, and Jan. 1 this year:

	Total Cost.	Per Cent.
1860—May 1	$61 55	100
186 —May 1	140 21	225
1865—May 1	118 77	185
1866—May 1	102 83	167
1867—May 1	116 46	189
1868—May 1	120 30	195
1869—May 1	96 50	156
1870—May 1	84 11	136
1871—May 1	82 98	134
1872—May 1	85 45	138
1873—May 1	81 43	132
1874—May 1	81 19	131
1875—May 1	76 48	124
1876—May 1	69 45	112
1877—Jan. 1	65 76	106

This shows that the average wholesale cost of the various articles of consumption is now but about 6 per cent. higher than in 1860, while the wages of railway employes are from 30 to 40 per cent. higher now than then. On the other hand the charges of the railroads for carrying freight have been enormously reduced, as will be seen by the following paragraph:

In 1860 the railway tariffs, based then, as they are now, upon the rate to Chicago, were 65 cents per 100 lbs. on wheat for six months—until May and after October—62 cents in October, 50 cents in July, August and September, and 45 cents in May and June. The average by months in 1860 was 59 cents per 100 lbs. on grain. But the average during the last twelve months has been only 28 cents—less than half as much. Nor has the reduction of receipts been confined to the grain traffic. The average receipts per ton per mile in cents and decimals, for all freight moved by the leading railways in 1860 and during their last fiscal year, compare thus:

	1860.	1877.
New York Central	2.06	1.51
Erie	1.84	1.09
Pennsylvania	2.12	.892
Lake Shore	2.02	.817
Pittsburg, Ft. W. & Chicago	1.90	.928
Average of all	1.99	.956

NEW MORDANT FOR FIXING COLORING MATTERS.

EVERY one knows that coloring matters soluble in water can be absorbed by pulverulent bodies of a certain kind with an avidity which appears to be the same as that with which textile fibres lay hold of the so-called substantive colors. It has been demonstrated in this journal, that starch seizes and retains with a very considerable power the aniline colors. Thus colored powders may be prepared which find numerous applications in manufacture of paper-hangings. We know that certain colorless precipitates, if formed in a liquid containing a coloring matter in solution, absorb very considerable quantities, and still appear only faintly tainted. Of this kind we obtain very elegant results with the sulphate of baryta, if precipitated in liquids holding aniline colors in solution.

All such precipitates, however, have but a very secondary interest for the art of dyeing, and up to the present time there is no pulverulent or porous body known which is in a condition to act upon coloring bodies, both substantive and adjective, absolutely in the same manner as the fibre itself.

In consequence of researches in dyeing with aniline colors upon cotton M. Reimann has succeeded in demonstrating the enormous power of absorption of silica and analogous substances for tinctorial bodies.

A compound of silicic acid has already been dyed with substantive colors. The attempt has been made, with more or less success, to communicate to powdered mica the brilliant hues of aniline dyes by steeping it in a solution of these products. But these attempts have never extended to other applications of the absorptive power of silica for colors.

The precipitate of silicic acid, which is separated from a solution of soluble glass on the addition of an acid, which appears in the form of a jelly, but is transformed on drying into a white, impalpable powder, proves, in a most striking manner, the property which it possesses, when brought in contact with the solutions of substantive colors, to seize hold of the coloring matter which they contain; and if mordanted and brought in contact with adjective colors, to dye up exactly in the same manner as a textile fibre. The dyes thus obtained are, at least, as solid as those upon vegetable fibre.

In particular, the aniline colors are thus capable of readily combining with silica which then appears colored in a perfect manner. If in a glass containing solutions of magenta, of aniline blue, violet, etc., we stir up silicic acid, precipitated and washed with care, this acid takes up an intense color, which it retains after washing with water. It is only on boiling with water, or on treatment with concentrated alcohol, that the color disappears. But this takes place also with dyed fibre—for instance, mordanted cotton, which is decolorised if boiled in water, and still more readily if treated with alcohol. We may thus succeed in dyeing amorphous silicic acid with the solution of aniline colors, obtaining very beautiful powder-colors, which may serve as pigments, and in the manufacture of paper-hangings.

But an application of far greater industrial importance is the utilization of these reactions in dyeing. Upon those fibrous matters, such as cotton, which do not take up the aniline colors directly and without preparation, it is easy to fix them by means of silicic acid. When the fibre of cotton, which shows itself extremely refractory against colors, is simply imbued with a compound of silicic acid easy of decomposition, it absorbs such colors, especially the anilines.

A simple passage through a solution of soluble glass suffices to give cotton this power of absorbing colors. But we succeed still better if we decompose the soluble glass upon the fibre; for this purpose the cotton, after being saturated with an alkaline solution of silica, and then steeped in dilute acid, so that the silica may be precipitated upon the fibre, if it is then cautiously washed and plunged into the solution of the dye, it takes a bright, lively color, and, in addition, the shades obtained are more solid than those produced with the numerous mordants now in use.

The mordanting of cotton for aniline colors has chiefly been confined to introducing the fibre into an acid, with which rosaniline, trimethyl-rosaniline forms salts sparingly soluble or altogether soluble. Tannic acid, on account of the insolubility of its salts, is preferred by cotton dyers. Yet the compounds of tannic acid have not as lively a color as the salts of the aniline bases as they existed in solution. Hence shades dyed with a tannin mordant always appear rather flat.

This fault is entirely removed by the use of silicic acid. It is in fact found that the aniline colors fixed upon cotton by means of this acid are purer, and resist soap and alkalies better than those fixed with ordinary mordants.

The great power of silicic acid for attracting and fixing colors will be still better appreciated if we observe that, contrary to all analogy, wool cannot be dyed directly with aniline green. A passage through soluble glass, dyeing in a beck of the green at hand-heat, followed by a passage through a weak acid, are all that is needed in this case.

These properties of silicic acid have already been applied in cotton dyeing on a large scale with the aniline colors, and have yielded admirable results.

M. Reimann has also undertaken other researches with the adjective colors, and has found that silicic acid lays hold of the different mordants, such as acetate of alumina and acetate of iron, precisely in the same manner as does cotton. It is thus that black shades may be dyed perfectly well.

It now remains to inquire if the silicic acid, like mica, is merely simply united to the coloring matter by a superficial attraction, or if this affinity is not perhaps due to a feeble proportion of alkali remaining in the precipitate. This last supposition presents itself to the mind so much the more readily, as it was found possible about a year ago that the aniline colors could be fixed upon cotton by an alkaline mordanting. M. Reimann has, therefore, sought to produce all the colorations obtained upon silicic acid upon the glass itself mordanted with fluoric acid.

If the affinity of silica for coloring matters merely depends on the presence of an alkali, experiments upon such mordanted glass ought to give a negative result, because much we could not imagine the presence of a soluble alkali. If, on the other hand, the affinity of the acid is attributed only to a physical property of its surface, the mordanted glass ought to give the same, or at least analogous results.

In fact, glass whose surface has been treated with fluoric acid seizes the aniline colors as perfectly as amorphous silica. The glass so prepared may even be mordanted with iron, and dyed black in a logwood beck, or a rust yellow, a royal blue, etc., may be produced. In consequence of the slight depth to which the mordant penetrates, as compared with the thickness of the glass, shades are certainly light, but as far as it penetrates it is as perfectly stable as that produced with silicic acid.—*Dingler's Polytech. Journal.*

SUBSTITUTE FOR OIL.—The following is a mixture said to be used by M. J. Scharr, in France, in place of oil in preparing wool for spinning. The following quantities yield four and a-half litres of the mixture:—Gum Arabic, 30 gr.; virgin resin, 30 gr.; linseed, 85 gr.; hemp seed, 60 gr.; olive oil, 145 gr.; fat oil (oleine), 145 gr.; borax, 45; liquid ammonia, 15 gr.; Castile soap, 340 gr.; American potash, 30 gr.; potato fecular, 75 gr. The composition is prepared in the following manner:—The gum, resin, seeds and potash are boiled together for about an hour, then the olive and fat oil being mixed together, and the ammonia mixed with the required quantity of water, the two are mixed and well stirred together, and finally, the latter is mixed with the former portion of the composition.

WITH iron mordants cochineal gives lilac or purplish shades of color, but they do not possess any especial beauty and are seldom worked.

WASHING AND CLEANSING WOOL.

A PROCESS described by M.M. Puech Frères, the inventors, consists in the means of extracting all the fleece from the skins of American sheep without altering the length, the consistency, or the regularity of the locks of wool, and at the same time washing and cleansing it completely. The process is thus described :—A hot bath is prepared with the addition of some cleaning substance, such as salts or crystals of soda; soap, and steep the dried skins therein for some minutes, until the grease separates from the wool, when the skins are passed through rollers to get rid of the water, and a part of the grease and other foreign matters; the skins are then washed in clear water until perfectly clean. The bleaching is effected by steeping the skins in a bleaching vat, drying them well in a centrifugal machine, and then the fleshy side of the skin is treated by what is called *égraminage*, but not explained, which has the effect of opening the pores of the skin, and facilitates the detachment of the roots of the wool, after which a depilatory substance is applied to the same side of the skin and the fleece is detached with ease in a short time. The wool is then dried, and presents a fleece-like mass, much finer than can be obtained by the old processes, and without any injury whatever to the skin.

REMARKS ON ANILINE BLACK.

IF hot concentrated solutions of an alkaline chlorate and of neutral muriate of aniline are mixed together, the liquid heats to a boil, becomes thick, and is converted into a tumid mass, giving off suffocating fumes, mixed with the vapor of a black volatile body, which on distillation gives off gaseous and liquid products among other aniline oils.

The same black is obtained by mixing the concentrated and acid solutions in the cold. After a short time the clear liquid takes a deep color, and is transformed into a thick paste, which gives off abundance of chlorine and volatile chlorine compounds. When the reaction is over we dilute and heat to a boil, when the black mass loses its greenish tone ; we then filter, wash, and dry.

The precipitate obtained is of a deep black, and if submitted to distillation it produces the same results as those given by the hot neutral liquid. Like the latter, it is insoluble in acids, alkalies and alcohol, and indifferent towards most chemical reagents. Naturally, neither the one nor the other can be used as a dye-bath. The fibre indeed takes a black color, but the black loses its solidity. To make use of such a mixture of an alkaline chlorate and of a muriate of aniline as a dye-bath it would seem necessary to employ solutions very dilute and perfectly neutral. Such, however, is not the case, for even on heating such solutions no reaction is perceived. Each of the conditions indicated hinders the decomposition of the chloric acid and the formation of aniline black. But it is upon this very decomposition of chloric acid in the dye-bath that, according to M. A. Guyard, is based the entire process of the formation of aniline black. If another means of introducing this decomposition exists, a dilute and neutral bath may be employed with success. Decomposition by reducing agents is not suitable in this case, the prussiate of potash forming the only exception. Oxidizing agents are no better. While the former give no result, the latter produce compounds soluble in acids and alcohol, and entirely different from aniline black. On the other hand certain metallic salts fulfil all the conditions for the production of a fine black with chlorate of aniline, for the salts of metals which have several degrees of oxidation pass easily from one to the other.

According to M. Guyard the salts of copper, iron, manganese, molybdic, and tungstic acids, and especially the vanadium compounds, decompose the chloric acid of aniline, reducing and oxidizing at once. They take from the chloric acid a part of its oxygen, transmit it to the aniline, thereby returning to a lower degree of oxidation, and continuing this alternate play till all the chloric acid is decomposed, or all the aniline is oxidized.—*Dingler's Polytechnic Journal.*

ANILINE BLACK ON CALICO.

CHLORATE OF AMMONIA.

Water, 157 fluid ozs.; liquid ammonia, specific gravity 0·9, 140 ozs.

Mix, and add 157 fluid ozs. water, in which have been dissolved 4 lbs. 6¼ ozs. tartaric acid.

Then add boiling water, 864¼ ozs.; chlorate of potash, 9 lbs. 10 ozs.

Stir till all is dissolved. This mixture should be neutral to test paper. Then put it in tartaric acid solution as above, 157 fluid ozs.; stir continually for a quarter of an hour, and afterwards at intervals throughout the day, while the mixture is cooling. When quite cool throw on a filter, and wash on the filter with 236 ozs. of water, adding the washings to the filtrate. The yield is 1,496 fluid ozs., at specific gravity 1·05.

THICKENING NO. 1.

Chlorate of ammonia solution as above, 1,260 fluid ozs.; starch, 17 lbs. 13 ozs.

Heat to 155° Fahr., incorporating thoroughly, and cool.

THICKENING NO. 2.

Chlorate of ammonia solution as above, 1,103 fluid ozs.; brown British gum, 39 lbs. 10 ozs. Heat also to 155° Fahr., and cool.

Equal quantities of these two thickenings are made ready for use.

COLOR.

Mixed thickenings, 1,260 fluid ozs.; muriate of aniline at specific gravity 1·1, 315 fluid ozs.; sulphide of copper paste, 77½ fluid ozs.

These mixtures should be prepared in stoneware pans, heated in the water bath, or in enamelled iron pans fitted with steam jackets.

SULPHIDE OF COPPER PASTE.

Caustic soda at specific gravity 1·35, 315 fluid ozs.; flowers of sulphur, 4 lbs. 14½ ozs. This is put in stoneware vessels, and frequently stirred with an iron ladle till the sulphur is all dissolved, which may take from 24 to 30 hours.

Add this all at once to 23 lbs. 13 ozs. crystals of blue vitriol dissolved in boiling water, 9,450 fluid ozs., and stir well; then make up with cold water to 15,750 fluid ozs. Let settle, and run off clear liquid, wash three times with cold water by decantation and draining on filter. The yield is about 420 fluid ozs. paste.

MURIATE OF ANILINE SOLUTION.

Aniline oil, 1,260 fluid ozs.; muriatic acid, at specific gravity 1·165 (=33° Twaddle) 1,015 fluid ozs. Water, 549 fluid ozs. The yield is nearly 2,800 fluid ozs., at specific gravity, 1·100. Or muriate of aniline crystals, 89 lbs. 11⅔ ozs.; aniline oil, 9 lbs. 13 ozs.; and about 1,400 grammes of water.

Instead of the chlorate of ammonia, chlorate of soda or chlorate of baryta may be used by substituting caustic soda or baryta for ammonia. In these cases it is less essential to avoid the use of copper pans.

ANILINE BLACK NO. 2.

Dissolve in 220 lbs. cold water—starch paste, 110 lbs.; chlorate of potash, 6 lbs. 9 ozs.; sal ammoniac, 5 lbs. 7½ ozs.; sulphide of copper paste, 10 lbs. 15 ozs. Before using add starch paste, 110 lbs.; liquid aniline (50 parts muriatic acid, and 46 parts aniline oil), 66 lbs. Print and age the moist goods. The color comes up a dark green. In order to judge if the color is dark enough, pass a swatch through a solution of soda crystals or chromate of potash, wash, and dry. If the shade is not full enough, age further. Lastly, take through a weak beck of carbonate of soda and chromate of potash.

ORANGE AND CHRYSOINE.

THESE are two new colors offered for sale by the eminent firm of A. Poirrier & Co., of Paris.

Both are perfectly soluble in boiling water, of which 50 to 100 parts are employed in practice, with the addition of a small quantity of potash.

For dyeing wool and silk a little sulphuric acid may be added to the dye-beck, as also a little tartar and alum. The quantity of sulphuric acid must be very small, or the colors do not take so well. Copper pans and utensils must be entirely avoided, as this metal totally changes the colors. They can be used not merely for yellows, mandarins, etc., but for browns, garnets, olives, and scarlets, along with extract of indigo, orchil; and for scarlet, with the "lutecienne," manufactured by the same firm, or with cochineal. Orange No. 1 is recommended in place of turmeric, fustic and aniline yellow, and its tones may be turned yellower by the addition of fustic, or redder by orchil. Orange No. 2 is employed for bright browns, garnets, olives, and along with lutecienne for scarlets. Chrysoine along with extract of indigo yields the best yellowish olives. It is faster than turmeric, and does not smear off like aniline yellow.

The prices are—Orange No. 1, 22s. per 2 lbs. 3 ozs.; No. 2, 20s.; No. 3, 22s. Chrysoine, 28s. per 2 lbs. 3 ozs.

EOSINE.

M. A. BAEYER has given some further particulars on the preparation of this important dye. The raw material, fluoresceine, is obtained by heating five parts of anhydrous phthalic acid and seven parts of resorcine to 392. The mass swells up, and becomes solid after three to six hours. From it fluorescine is obtained by extraction with boiling alcohol, and is insoluble in cold water, sparingly soluble in hot, but dissolves freely in alcohol and ether. It is a feeble acid, and dyes wool a fast yellow with a reddish tone. If treated with nitric acid it yields tetranitrated fluoresceine, an orange compound, which dyes wools, and dissolves alkalies with a violet color.

If fluoresceine is suspended in glacial acetic acid, or in alcohol, and treated with bromine, there is produced tetra-bromfluoresceine, otherwise known as eosine. For this purpose fluoresceine is mixed with four parts of glacial acetic acid, and a solution of bromine, in glacial acetic acid, containing 20 per cent. of the former, is added. Tetra-bromfluoresceine (eosine) separates from the solution in orange crystals. The potash-salt of eosine is obtained by treating an excess of tetra-bromfluoresceine with potash-lye, filtering, concentrating in the water-bath, and allowing to crystallize. This compound is known in commerce as soluble eosine (water-eosine), whilst the free eosine requires to be dissolved in spirit.

SOLUBILITY OF SILK IN AN ALKALINE GLYCERINE SOLUTION OF COPPER.

SCHLOSSBERGER mentions as a solvent for silk an ammoniacal solution of the oxide of nickel. Persoz mentions chloride of copper, and Spiller concentrated hydrochloric acid. A cold alkaline solution of the oxide of copper in glycerine yields in effectiveness to none of these. Silk dissolves slowly in very dilute solutions, but in those of medium strength the silk swells up almost immediately, and soon dissolves, forming a thick liquid, from which muriatic acid precipitates the silk in the form of a whitish jelly. This solvent power of the alkaline glycerine solution of copper does not extend to cotton, linen, or wool, which permits these fibres to be separated from silk.

Silk dyed black with salts of iron dissolves much less easily and less completely. But if we previously digest such black silk with an alkaline sulphuret, and if we then remove the sulphuret of iron thus formed with muriatic acid, we may then effect the solution more easily.

Silks dyed by other processes do not present the same resistance.

Wool is stained black by the alkaline glycerine solution of copper, but this colorization is easily removed by dilute acids.

To obtain the glycerine solution of copper, we dissolve 10 parts of blue vitriol (pure) in 140 to 160 parts of distilled water; add 8 to 10 parts of glycerine at 1·24 specific gravity, and then pour into it caustic soda, drop by drop, till the precipitate of hydrate of copper first formed is redissolved, and finally filter. The solution suffers no change on keeping. Too large an excess of soda should be avoided.—*Dingler's Polytechnisches Journal.*

SULPHOLEIC ACIDS.

AT the same meeting M. Schaeffer drew attention to the sulpholeic acid or sulphated oils, which are now sold under various and fantastic names, as the source of fatty matters in alizarine red printing and dyeing. It was considered desirable that this body should be studied, and an attempt made to explain what its action was ; the study of the question was entrusted to Messrs. Goppelsroeder and Weber.

This modification of oil was first introduced by Mercer and Greenwood in their patent of June 22d, 1846 ; but, as far as we know, was not found to possess any advantage over ordinary oil for Turkey red dyeing. Its manufacture has been from time to time revived, and various applications attempted, but without permanent success. Modifications of it are now in use in many places for the production of alizarine red, and it will be of interest to know what the Mulhouse chemists think of it. Several samples have come under our hands in a more or less crude form. One, purporting to be the article discovered by Storck, and sold by Honore & Co., seems more carefully manufactured than most of the others. It is perfectly clear oil, shows about 4 per cent. of sulphuric acid when decomposed, and contains ammonia. It is miscible with cold water, and makes a clear solution in warm water. Its base would appear to be mainly castor oil These sulpho-oils must be distinguished from the so-called soluble oil used mostly as a softener for finishing goods. It is nothing but castor oil soap, which is remarkably soluble in cold water. It is difficult to see what other advantage as a softener, besides its liquid state, it can have over any other kind of soap.—*Textile Colorist.*

APPLICATION OF ELECTRICITY IN DYEING.—According to the *Bulletin de la Societe Industrielle de Mulhouse*, Goppelsroeder has observed that if an electric current is passed through aniline dye-becks decoloration ensues, with formation of colorless salts of leukaniline. If yarns or cloths are steeped in the liquid they absorb it, and on subsequent exposure to the air they become colored, just like the goods drawn out of an indigo vat and exposed to the air. The colors thus obtained are said to be faster than those produced by the ordinary method. Whether this principle of dyeing will prove practically useful remains to be seen.

CRIMSON and cherry colors upon wool are obtained by using a certain proportion of ammoniacal cochineal along with ordinary cochineal, the other materials and the process being the same as for scarlets, except that sometimes alum is added to the dye liquor. The shade tends more and more to the blue side as the proportion of alum and ammoniacal cochineal is increased. Pink colors upon wool are obtainable from the ammoniacal cochineal alone, with alum and tin for mordant. Cochineal dyes very well upon silk with a simple muriate of tin mordant, the bichloride being usually employed; the shade from crimson to pink being produced by simply using different proportions of the coloring matter to a given weight of silk.

APPLICATION OF ALBUMEN.—The following is by M. Zingler: Blood deprived of its fibrine is treated with a certain amount of turpentine, spirit of resin, or other hydrocarbon, which develops peroxide of hydrogen by the absorption of oxygen, and a current of air is forced through the mixture heated to about 150° C., or higher. The disinfectant made use of is that of Kingzett and Zingler. The colorless albumen is mixed with the colors of the consistency required for dyeing or printing tissues or other fabrics. Tissues, after having been dyed or printed, are either passed through cylinders or steamed. Aniline colors are dissolved before being mixed with the albuminous solution.

MORDANT FOR TURKEY RED.

THIS new product, made by MM. P. Lhonore et Cie, of Havre, and others, is said to have made an important change in the methods of dyeing Turkey red. M. Storck describes the mode of use as follows:

1. *Dyeing in Turkey Red.*—After having passed the unbleached calico through a solution of salt of soda at 3° Baumé, and washed and dried it in the open air, it is fulled in a bath containing 3 to 4 parts of red Turkey mordant to 100 parts of tepid water; dry in stove room. The operation may be performed on the calico damped, but in that case it should be passed twice through the preparation mordant with acetate of alumina at 2° B., and ungum after proper airing with dung and chalk. The acetate may be made with

Water	100 litres.
Alum	60 kilos.
Pyrolignite of lead, at 5° B.	52½ "
Chalk	1½ "

Dissolve hot; let it settle, and employ the clear liquor.

Dye with artificial yellowish alizarine at

15 (quality special for red dye)	1,200 grms.
Bran	2,400 "
Turkey red mordant	500 "
Water	150 to 200 litres.

The above quantities were for 10 kilogrammes of calico.

Introduce the calico cold; then raise the temperature, so as to reach 90° C. in an hour and a half. The dye vat should be as neutral as possible, and care must be taken to correct the water, if necessary, by an addition of sulphuric or acetic acid. After the pieces are properly washed, pass them for half an hour through water, to which has been added 2 grammes per litre of Turkey red mordant, or, which is better, work the calico a second time in a solution containing 4 per cent. of the mordant; then dry, without washing, on the drums, and steam for 20 minutes at Ok. 5 per square centimetre; next, pass it once or twice through a closed boiler containing the following mixture:

Soap	4,000 grammes.
Soda crystal	1,000 "
Salt of tin	200 "

Rinse and dry in air. The color obtained by this method is equal to the finest Turkey reds produced by the old processes, while it is much cheaper and more rapidly effected. The same method is equally applicable to cotton yarn.

2. *Printing in Turkey Red.*—The Turkey red mordant being a fatty matter that will mix with water in any proportions, may be employed in the printing of tissues, in the same manner as oil, over which it possesses incontestable advantages. Excellent results are obtained with artificial alizarine, aniline colors with albumen, in fine toned reds, etc. Added in the dyeing of tissues printed with red or violet mordants, it adds much brilliancy to the tints. The proportions to be taken are as follows: To 1 part of alizarine of 15 per cent.; 2 parts of bran; 1 part of Turkey red mordant. Dry after dyeing, steam, and treat with the following boiling mixture:

1,000 litres of water.
3 to 4 kilos. of soap.
500 grammes of soda crystals.
200 grammes of salts of tin.

The above is for the reds; violets only require to be passed through boiling water, and treated with chlorine. It must be added that the addition of Turkey red mordant prevents the parts of the tissues which are not printed from taking color, and that the white is as fine after the dyeing as is usually obtained after several soapings in the ordinary method.

It applies equally to the preparation of calico, to be printed with steam colors. In this case the calico is treated

in a bath containing 4 parts of Turkey red mordant to 100 parts of water, and then stone dried. The artificial alizarine reds and rose tints become very brilliant on tissues treated in this manner. The soaping becomes needless, and mere passing through tepid water, containing 3 grammes of alum to the litre, gives beautifully pure tints. It will be evident that this system allows of the association of steam colors of the most various kinds, such as prussiate steam green and blue, aniline black, steam yellow, etc., with alizarine colors. M. Storck offers dyers a special series of receipts for this kind of printing.

FAST PUCE FROM ARTIFICIAL COCHINEAL.

THIS new coloring matter, which promises to become a substitute for cochineal, as alizarine has for madder, is extremely economical. The following is the method employed:

For 10 kilogrammes of woolen yarn, dissolve together

Artificial cochineal	45	grms.
Orange palatine	30	"
Borax	100	"

Boil for 15 minutes; then add

Tartaric acid	100	grms.
Acetate of alumina prepare with alum,	2·400	kilos.
Acetate of lead	0·800	"
Water	60	litres.

The acetate thus produced to be added half at a time. If the bath is not perfectly clear, add a little more tartaric acid.

For 10 kilogrammes of woolen tissue, prepare a bath with

Tartar crystals, half refined	1	grms.
Tartaric acid	0·500	"
Salt of tin	0·500	"
Oxalic acid	1	"

Boil for 15 minutes and then add

Artificial cochineal	80	grms.
Concentrated flavine	30	"

Work boiling for half an hour.

ALUM TREATMENT OF SILK.

A DYER communicates the following notes on "alum for silks" to the *Manufacturist*, and writes that alum is used in the silk dyeing processes as a general mordant, as it is in all dye stuffs when the color has to be fixed by a mordant.

Every dye solution, in whatever form, becomes precipitated by the addition of an alum solution, that is to say, the coloring portion of the decoction, or the pigment itself enters into solid combination with the alum, and so falls to the bottom as residue. The remaining liquid becomes thus more or less poor in dye, and if the proportion of the alum has been rightly chosen in comparison to the dye-stuff, the latter becomes even as clear as water. This residue, or precipitate, may be thus explained as the combination of the alum used with the dye liquid, and throws off the color which would result in the actual dyeing process.

The point of limit of saturation, or the necessary quantity of alum to be used for precipitating all dye-stuff in dye-liquors, is not equal for all colors; for instance, a decoction of cocenilla requires three or four times as much alum to precipitate the whole of its red pigment than would be similarly required for other dye stuffs.

This fact not merely explains the alum process used in silk, but it also follows that every dye is a precipitate which requires a certain quantity of alum to become saturated.

A decoction of 1 kilog. of madder, fustic, or quercitron becomes totally precipitated by 66 gr. of fine powdered or dissolved alum, whereas a decoction of 1 kilog. of campeachy only requires 45 gr.

On an average, 250 gr. of alum will be found sufficient per kilog. of silk, for reason that it can take up the necessary amount of alum from this alum solution.

If dye decoctions are precipitated when in a hot state, the precipitates are not as handsome as when the decoctions are first very much diluted, and subsequently precipitated, after being quite cold. The same remark applies also to silk, for if it is treated with alum when boiling hot, such a good dye is not obtained as when the silk is treated cold.

Inasmuch as silk takes up alumina in the alum process, it thus becomes extra weighted; this increase in weight, however, never exceeds 8 per cent.; for instance, if 1,900 grammes of silk are subjected to 500 grammes of alum during 4 or 5 days, and then dried, the silk will weigh 1,980 grammes after washing and redrying.

Silk can, however, be more over-weighted by using acetate of alumina instead; this can be done, for instance, by dissolving 1 kilog. of alum in water, and adding 1 kilog. of sugar of lead to it. The clear alum solution is then poured from the precipitate, and serves for the alum process.

If silks impregnated with acetate of alumina are dried, the acetate becomes volatile, and the alumina remains fixed on the silk, and as it does not wash away so easily, the silk gains more in weight. In this manner silk can be over-weighted to the extent of 12 per cent.

ON DYEING IN WOODEN BECKS.

M. A. WULLNER has repeated the observation of a fact, very important to dyers, that steam of the temperature of 212° F., if conducted into water, is capable of making it boil. If we introduce steam at 212° F., not into water, but into a saline solution boiling at a temperature above 212°, say 230°, or 248°, it is raised to a boil by steam at 212°. The steam which rises from such a boiling saline solution is hotter, therefore, than the steam which enters.

It is known that this excess of temperature acquired by the saline solution is due to the latent heat which exists in the steam of water boiling at 212° F. (about 550 heat equivalents).

This simple fact is the basis of our new system of wool dyeing, for if steam could not raise to a boil a saline solution boiling at a higher temperature, it would not be possible to dye in wooden becks by the introduction of steam from the boiler, and, consequently, the wool-dyeing of the day could not have reached its present point.

A flot of mordant holding a metallic salt in solution could not be boiled in wooden cisterns, any more than could the most of our dye becks. Besides this, the variations of the barometer cause water to boil often, not merely at 212° F., but at a lower temperature. Many colors can only be fixed at temperatures exceeding 212° F., such as aniline violet.

This is why a little saline matter is occasionally added to dye becks, in order to raise the boiling point above 212° F. This may be either common salt, sulphate of soda, or any other compound free from destructive action upon colors.

Hitherto it was believed that raw wool could not be dyed without the action of direct fire, and this view was supposed to be proved by the fact that the colors for raw wool required a temperature higher than 212° F., which it was imagined could only be obtained by a direct fire.

But as we can raise the temperature of the boiling liquid in a wooden beck by the addition of a neutral salt, we no longer see the necessity or the advantage of an open fire.—*Teinturier Practique.*

APPLICATION OF CHROME IN PRINTING.

A NOTE on this important subject has been presented by MM. J. Dépierre and B. Tatarinoff to the Industrial Society of Rouen.

After alluding to the various and interesting combinations into which the metal chromium enters, the authors state that a new method of fixing it in a state of chromate of lead had been discovered by M. Storck and De Coninck, an interesting fact being that the chromate is obtained by steaming. The authors had tried to apply this mixture to printing, but they did not arrive immediately at a satisfactory result.

By employing dark, roasted starch instead of the substance known as marine gum or lychó, the writers of the note succeeded in producing yellows and oranges by impression, according to the proportions of the salt employed. It is by the decomposition of chlorate of chrome in presence of acetate of lead that this effect is produced, and it is particularly these applications of the chromate of chrome of which we wish to speak.

The salt, which is not mentioned in the most recent chemical works, is easily prepared by means of sulphate of chromium and chlorate of barytes. In practice the alum of chrome is used, which gives at the same time chlorate of potash, which, however, causes no inconvenience. If a small quantity of chlorate of chrome be placed in a tube and heated, it will be observed that a change takes place at about 50° to 60° C.; if then a salt of lead be added, a precipitate of chromate will be formed; but if the liquor of chlorate of chrome, either by itself or mixed with a salt of lead, be heated to a boiling point, although it becomes decomposed, it remains green.

The chlorate of chrome dissolves at the ordinary temperature about one-fifth of its own weight of hydrate of oxide of chrome, but the latter must be of recent preparation. The hydrate, when dried, and Guignet's green will not dissolve. This basic solution has the same qualities as that of the normal chlorate, but a little less decided. At a temperature near to the boiling point, chloruretted gas is produced, and the remaining solution gives, with nitrate of lead, a yellow precipitate. The nitrate, however, must not be used in printing, on account of the disengagement of nitric acid, which would attack the tissue. Even with the acetates, quantity must be carefully considered, whether of the chloruretted product obtained, or of the chromic acid, for the tissue is endangered when nothing is put in these colors to counteract these destructive actions. The basic chlorate of chrome should be prepared immediately, before it is to be employed, for if it remain some time—say several days—suroxidation of the oxide of chrome takes place when the latter becomes converted into chromic acid. Its presence is readily detected by acetate of lead, which, without heat, gives a precipitate of chromate of lead, which normal chlorate does not.

If a sample of indigo blue, previously impregnated with a solution of chlorate of chrome, whether basic or normal, be heated, it will be discolored. The same effect takes place in alizarine red, neutral or artificial, dyed, or fixed by steam.

The action of discolorization due to the formation of chromic acid and chloruretted gas had already been observed by M. E. Schlumberger in the decomposition of chlorate of alumina by heat. "Only," said he, "if the solution be previously saturated with alumina, the same phenomena do not occur, no hypochloric oxide is produced, only a slight white cloudiness, arising from the separation of a little of the alumina, and, by operating with care, the solution may be evaporated to dryness without the salt being decomposed. A sample of cotton dyed with indigo is not attacked cold by either of the solutions; but if heated the indigotine is destroyed in the acid solution, but not in that which is saturated."

In the last case there is no formation of hypochloric oxide, where the gas will combine by preference with the alumina in excess, while with the chlorate of chromium, whether normal or basic, there is always colorization of the indigotine and the alizarine: the decolorization taking place, not only by the action of chloruretted gas, but also by that of the chromic acid.

For printing yellow we have employed the following recipes:

COLOR NO. 1.

	Grammes.
Chlorate of chrome, at 15° B.	310
Crystallized acetate of lead	76
Marine gum, added cold	30

COLOR NO. 2.

Chlorate of chrome, at 15° B.	260
Crystallized acetate of lead	38
Marine gum	22

Color No. 1 does not weaken the tissue but gives a greenish yellow; No. 2 attacks the tissue, but produces a bright and truer yellow. If No. 1 be steamed it gives a greenish yellow; the quantities of acetate of lead used being probably too large to give neuter chromate of lead. The facts upon which we arrive at this conclusion are as follows: If we take a smaller quantity of acetate, say 14 per cent. or that of color No. 2, we obtain a more intense yellow, but which will not with lime give orange, while the other yellow will turn to that color without difficulty, although preserving a characteristic tint. If the two colors be printed on a medium indigo blue, 24 per cent. of acetate will give a dull yellow, while the reduced dose of 14 per cent. yields a pure yellow, the indigo being completely transformed. In the former case the tissue is not sensibly affected, while it is decidedly so in the latter. This may, however, be remedied by adding a small quantity either of chalk, lime, acetate of alumina, or oxide of lead. If the No. 2 yellow be passed through weak hydrochloric acid, at tepid heat the tissue will be turned white.

Yellow No. 1 gives a fine orange or medium blue, but, although covering well, does not bite in perfectly, while No. 2 holds perfectly and allows of producing white and yellow, but not orange. Thus by the combination of these two colors, modified according to the intensity of the indigo blue, are obtained by steaming solid white, and orange or blue.

As it is not necessary to steam immediately after printing, aniline black may be used simultaneously and other effects produced.

Chromate of chrome, simply thickened and steamed, destroys indigo blue as well as red. It should be noted that the artificial alizarine reds resist better. The white produced is doubtful, we have never been able to produce it pure.

If about 50 per cent. of acetate of alumina at 10 per cent. B., be added to chlorate of chrome, and this printed in blue be steamed, the tissue will then take red from garancine or alizarine.

Chlorate of chrome, according to the reporters, promises to play a certain part, not only in the production of yellow or orange by steaming, but also as a means of fixing the other coloring matters, such as aniline, catechu, and logwood, especially when employed in the form of basic chlorate; but it must be remembered that starch and not marine gum must be used with it.

Thus, the following will give a rather greenish black by oxidation:

	Grammes.
Chlorate of chrome at 15° B.	200
Sal ammoniac	25
Aniline	20
Hydrochlorate of aniline	100
Peroxide of iron in paste at 50·000	50
Hot water	200
Starch and gum tragacanth	500

It must be noted, however, that in spite of the large quantity of base in the above the tissue is somewhat affected.

The above quantities are merely given suggestively, and we believe that good results will be obtained by modifying them. The catechu fixes easily and gives a color, offering great resistance. A fine black is obtained with logwood, and especially when a little catechu is added to it. The colors stand pretty well.

In printing with chlorate of chrome thickened with dark roasted starch, and proceeding to dye after ungumming in silicate or wine lees, color is obtained with garacine. Passed through ammonia, the white is less pure and the chrome colors less easily; while if silicate be used for ungumming, bright tints are obtained, and without the white being affected.

The basic chlorate, treated in the same way, gives a color with more body; but, in all cases, the ungumming must be done at a low temperature, that is to say, 40° C.; at 65° to 70° much less of the oxide will be fixed.

The nitro-alizarine colors this chrome mordant in catechu, but, singularly enough, it yields much less than the other salts of chrome, with the same amount of oxide. We have printed one color with acetate of chrome, another with nitrate, and a third with chlorate.

The colors, previously fixed, ungummed with silicate, and dyed in garancine, artificial alizarine, quercitron (nitro-alizarine excepted) gave the fullest rendering with the chlorate. The acetate yielded the least. If nitro-alizarine be used for dyeing, it is found that the nitrate has more effect. This property of the nitro-alizarine has also been observed in alizarine orange fixed by an alum mordant. The nitro alizarine fixed on the nitrate gives an orange of a more than that obtained by the acetate.

The reporters say, "We are far from having exhausted the list of applications of chlorate of chrome; but imperfect as have been our experiments, they appear to possess a certain interest, and for this reason we present them."

BLEACHING CHINA CLAYS.

IN order to remove the organic or coloring matter which china clays contain in their natural state at a certain stage in the process of their preparation or manufacture, and whilst the clays are in a liquid or running state, Mr. John Carr, of Cardiff, England, proposes to treat them by adding to them a composition composed of chlorine gas, by parts, 100; hydrochloric acid, by parts, 100 to 200 parts; water and clay combined, 100 parts; sulphurous acid gas and water to 300 parts, water and clay combined; sulphuric acid, 100 parts to 400 parts, water and clay combined; hyposulphite of soda, bisulphite of soda, and hypochlorite of soda: these are all used in combination with the before mentioned chemicals according as the various qualities of clay require; oxalic acid, by parts, 100; to water and clay combined, 150 parts. The action of all these chemicals on the clay is to effect the process of bleaching without breaking up the component parts of the china clay. The bleaching action commences within 60 minutes after application, but the longer the acid is allowed to remain in the clay tank mixed with the clay the more effectual and economical is the process, as china clays vary very much as to the quantity of organic matter originally contained in them. Another advantage of this process is that when acids are used without the gas the solution may be worked over again by conveying it back over the clay stopes, thereby reducing the original quantity required for the purpose of bleaching. When, by means of the action of the chemical before mentioned, the process of bleaching has been completed, the clay is then dried in a kiln as usual. The improved apparatus for producing the sulphurous acid gas required in this invention consists of an erection constructed of fire-bricks and clay, measuring about 6 ft. in length, 6 feet in height, and 3 ft. in width, divided into three compartments or chambers, and numbered 1, 2, 3, respectively.

The dimensions of the several chambers vary. Usually, compartment No. 1 is about 2 ft. high, 1 ft. 6 in. wide, has a semi-arched roof; in this arched roof he places sulphur and sulphuric acid which are ignited and kept constantly burning either by means of air supplied through a suction pipe inserted within 9 in. of the top of the chamber No. 3, or by a fire lighted underneath the slab on which are placed the sulphur and sulphuric acid above named; this chamber is also provided with an aperture through which the gas escapes and passes into chambers 2 and 3. Chamber No. 2 is about 3 ft. by 1 ft. 2 in., is filled with clean gas coke, and at its extreme end there is fixed a 4-in. earthen pipe, about 1 ft. long, to which is attached a leaden pipe of corresponding diameter, and sufficiently long to convey the gas water to the clay as it runs through glazed earthen pipes, or covered launders, from the micus to the settling pits. Chamber No. 3 is about 5 ft. high, 1 ft. 2 in. square, having a small aperture at the top, in which is placed a pipe of 3/8-inch bore. This pipe conveys a constant stream of water into this chamber, which is also filled with clean gas coke like unto chamber 2, the water passing down through the before mentioned coke becomes impregnated with the generated sulphurous gas passing out through the pipe inserted at the end of chamber 2. Within

9 in. of the top is a suction pipe, 3 in. in diameter, referred to in the description of chamber 1, and is carried out to the nearest stream of water to keep up the ignition of chamber 1, and thus dispense with the use of a fire; but the apparatus is provided with a suitable fire-place and ash-pit for use when no stream of water is near at hand for feeding this suction pipe.

[Continued from SUPPLEMENT No. 90.]

ANCIENT LIFE IN AMERICA.

By PROF. O. C. MARSH.

SLOTHS THAT WENT TO SOUTH AMERICA.

It is frequently asserted, and very generally believed, that the large number of huge *edentata* which lived in North America during the post-pliocene, were the results of an extensive migration from South America soon after the elevation of the Isthmus of Panama, near the close of the tertiary. No conclusive proof of such migration has been offered, and the evidence, it seems to me, so far as we now have it, is directly opposed to this view. No undoubted tertiary edentates have yet been discovered in South America, while we have at least two species in our miocene, and during the deposition of our lower pliocene large individuals of this group were not uncommon as far north as the forty-third parallel of latitude, on both sides of the Rocky Mountains. In view of these facts and others which I shall lay before you, it seems more natural to conclude from our present knowledge that the migration which no doubt took place was from north to south. The edentates finding thus in South America a congenial home flourished greatly for a time, and, although the larger forms are now all extinct, diminutive representatives of the group still inhabit the same region.

ORIGIN OF HOOFED ANIMALS.

The ungulates are the most abundant mammals in the tertiary, and the most important, since they include a great variety of types, some of which we can trace through their various changes down to the modified forms that represent them to-day. Of the various divisions in this comprehensive group, the perissodactyle, or odd-toed ungulates, are evidently the oldest, and throughout the eocene are the prevailing forms. Although all of the perissodactyles of the earlier tertiary are more or less generalized, they are still quite distinct from the artiodactyles, even at the base of the eocene. One family, however, the *coryphodontidæ*, which is well represented at this horizon, both in America and Europe, although essentially *perissodactyle*, possesses some characters which point to a primitive ungulate type from which the present orders have been evolved. Among these characters are the diminutive brain, which in size and form approaches that of the reptiles, and also the five-toed feet from which all the various forms of the mammalian foot have been derived. Of this family, only a single genus, *coryphodon* (*bathmodon*), is known, but there were several distinct species. They were the largest mammals of the lower eocene, some exceeding in size the existing tapirs.

In the middle eocene, west of the Rocky Mountains, a remarkable group of ungulates makes its appearance. These animals nearly equaled the elephant in size, but had shorter limbs. The skull was armed with two or three pairs of horn-cores, and with enormous canine tusks. The brain was proportionally smaller than in any other land mammal. The feet had five toes, and resembled in their general structure those of *coryphodon*, thus indicating some affinity with that genus. These mammals resemble in some respects the perissodactyles, and in others the proboscidians yet differ so widely from any known ungulates, recent or fossil, that they must be regarded as forming a distinct order, the *dinocerata*.

Besides these peculiar mammals, which are extinct, and mainly of interest to the biologist, there were others in the early tertiary which remind us of those at present living around us. When a student in Germany some twelve years ago, I heard a world-renowned professor of zoölogy gravely inform his pupils that the horse was a gift of the Old World to the New, and was entirely unknown in America until introduced by the Spaniards. After the lecture, I asked him whether no earlier remains of horses had been found on this continent, and was told in reply that the reports to that effect were too unsatisfactory to be presented as facts in science. This remark led me, on my return, to examine the subject myself, and I have since unearthed, with my own hands, not less than thirty distinct species of the horse tribe, in the tertiary deposits of the West alone; and it is now, I think, generally admitted that America is, after all, the true home of the horse.

I can offer you no better illustration than this of the advance vertebrate palæontology has made during the last decade, or of the important contributions to this progress which our Rocky Mountain region has supplied.

The oldest representative of the horse at present known is the diminutive *eohyppus* from the lower eocene. Several species have been found, all about the size of the fox. Like most of the early mammals, these ungulates had forty-four teeth, the molars with short crowns, and quite distinct in form from the premolars. The ulna and the fibula were entire and distinct, and there were four well-developed toes and a rudiment of another on the fore feet and three toes behind. In the structure of the feet, and in the teeth, the *eohippus* indicates unmistakably that the direct ancestral line to the modern horse has already separated from the other perissodactyles. In the next higher division of the eocene, another genus (*orohippus*) makes its appearance, replacing *eohippus*, and showing a greater, although still distant, resemblance to the equine type. The rudimentary first digit of the fore foot has disappeared, and the last premolar has gone over to the molar series. *Orohippus* was but little larger than *eohippus*, and in most other respects very similar. Several species have been found in the same horizon with *dinoceras*, and others lived during the upper eocene with *diplacodon*, but none later.

Near the base of the miocene, in the brontotherium beds, we find a third closely allied genus, *mesohippus*, which is about as large as a sheep, and one stage nearer the horse. There are only three toes and a rudimentary split bone on the fore feet and three toes behind. Two of the premolar teeth are quite like the molars. The ulna is no longer distinct, or the fibula entire, and other characters show clearly that the transition is advancing. In the upper miocene, *mesohippus* is not found, but in its place a fourth form, *miohippus*, continues the line. This genus is near the *anchitherium* of Europe, but presents several important differences. The three toes in each foot are more nearly of a size, and a rudiment of the fifth metacarpal bone is retained. All the known species of this genus are larger than those of *mesohippus*, and none pass above the miocene.

This genus, *protohippus*, of the lower pliocene, is yet more equine, and some of the species equaled the ass in size. There are still three toes on each foot, but only the middle one, corresponding to the single toe of the horse, comes to the ground. The genus resembles most nearly the *hipparion* of Europe. In the pliocene, we have the last stage of the series before reaching the horse, in the genus *pliohippus*, which has lost the small hooflets, and in other respects is very equine. Only in the upper pliocene does the true *equus* appear, and complete the genealogy of the horse, which in the post-tertiary roamed over the whole of North and South America, and soon after became extinct. This occurred long before the discovery of the continent by Europeans, and no satisfactory reason for the extinction has yet been given. Besides the characters I have mentioned, there are many others, in the skeleton, skull, teeth, and brain of the forty or more intermediate species, which show that the transition from the eocene *eohippus* to the modern *equus* has taken place in the order indicated, and I believe the specimens now at New Haven will demonstrate the fact to any anatomist. They certainly carried prompt conviction to the first of anatomists, who was the honored guest of the Association a year ago, whose genius had already indicated the later genealogy of the horse in Europe, and whose own researches so well qualified him to appreciate the evidence here laid before him. Did time permit I might give you at least a probable explanation of this marvelous change, but justice to the comrades of the horse in his long struggle for existence demands that some notice of their efforts should be placed on record.

THE HISTORY OF THE SWINE.

The artiodactiles, or even-toed ungulates, are the most abundant of the larger mammals now living; and the group dates back at least to the lowest eocene. In every vigorous primitive type which was destined to survive many geologic changes, there seems to have been a tendency to throw off lateral branches, which became highly specialized and soon died out, because they are unable to adapt themselves to new conditions. The narrow path of the persistent suilline type, throughout the whole tertiary, is strewn with the remains of such ambitious offshoots, while the typical pig, with an obstinacy never lost, has held out in spite of catastrophes and evolution, and still lives in America to-day. The genus *platygonus* is represented by several species, one of which was very abundant in the post-tertiary of North America, and is apparently the last example of a side branch, before the American suillines culminate in existing peccaries. The feet in this species are more specialized than in the living forms; and approach some of the peculiar features of the ruminants; as, for example, a strong tendency to coalescence in the metapodial bones. The genus *platygonus* became extinct in the post-tertiary, and the later and existing species are all true peccaries. No authenticated remains of the genera *sus*, *porcus*, *phacochœrus*, or the allied *hippopotamus*, the old world suillines, have been found in America, although several announcements to that effect have been made.

In the series of generic forms between the lower eocene *eohyus* and the existing *dicotyles*, which I have very briefly discussed, we have apparently the ancestral line ending in the typical American suillines. Although the demonstration is not yet as complete as in the lineage of the horse, this is not owing to want of material, but rather to the fact that the actual changes which transformed the early tertiary pig into the modern peccary were comparatively slight, so far as they are indicated in the skeletons preserved, while the lateral branches were so numerous as to confuse the line. It is clear, however, that from the close of the cretaceous to the post-tertiary, the bunodont artiodactyles were especially abundant on this continent, and only recently have approached extinction.

The selenodont division of the artiodactyles is a more interesting group, and, so far as we now know, makes its first appearance in the upper eocene of the west, although forms, apparently transitional, between it and the bunodonts, occur in the dinoceras beds, or middle eocene. The most pronounced selenodont in the upper eocene is the *oromeryx*, which genus appears to be alluded to in the existing deer family, or *cervidæ*, and if so, is the oldest known representative of the group. These facts are important, as it has been supposed, until very recently, that our eocene contained no even-hoofed mammals.

CAMELS, DEER, ELEPHANTS.

A most interesting line, that leading to the camels and llamas, separates from the primitive selenodont branch in the eocene, probably through the genus *parameryx*. In the miocene, we find in the *pœbotherium* and some nearly allied forms unmistakable indications that the cameloid type of ruminant had already become partially specialized, although there is a complete series of incisor teeth, and the metapodial bones are distinct. In the pliocene the camel tribe was next to the horses, the most abundant of the larger mammals. The line is continued through the genus *procamelus*, and perhaps others, and in this formation the incisors first begin to diminish, and the metapodials to unite. In the post-tertiary we have a true *auchenia*, represented by several species, and others in South America, where the alpacas and llamas still survive. From the eocene almost to the present time, North America has been the home of vast numbers of the *camelidæ*, and there can be little doubt that they originated here, and migrated to the Old World.

The deer family has representatives in the upper miocene of Europe, which contains fossils strongly resembling the fauna of our lower pliocene, a fact always to be borne in mind in comparing the horizon of any group in the two continents. Several species of *cervidæ*, belonging to the genus *cosoryx*, are known from the lower pliocene of the West, but all have very small antlers, divided into a single pair of tines.

The proboscideans, which are now separated from the typical ungulates as a distinct order, make their first appearance in North America in the lower pliocene, where several species of mastodon have been found. This genus occurs also in the upper pliocene, and in the post-tertiary; although some of the remains attributed to the latter are undoubtedly older. The pliocene species all have a band of enamel on the tusks, and some other peculiarities observed in the oldest mastodons of Europe, which are from essentially the same horizon. Two species of this genus have been found in South America, in connection with the remains of extinct llamas and horses. The genus elephas is a later form, and has not yet been identified in this country below the upper pliocene, where one gigantic species was abundant. In the post pliocene remains of this genus are numerous. The hairy mammoth of the Old World (*elephas primigenius*) was once abundant in Alaska, and great numbers of its bones are now preserved in the frozen cliffs of that region. This species does not appear to have extended east of the Rocky Mountains, or south of Columbia River, but was replaced there by the American elephant, which preferred a milder climate. Remains of the latter have been met with in Canada, throughout the United States, and in Mexico. The last of the American mastodons and elephants became extinct in the post-tertiary.

Perhaps the most remarkable mammals yet found in America are the *tillodontia*, which are comparatively abundant in the middle and lower eocene. These animals seem to combine the characters of several different groups, viz.: The carnivores, ungulates and rodents. In the genus *Tillotherium*, the type of the order, and of the family *tillotheridæ*, the skull resembles that of the bears; the molar teeth are all of the ungulate type; while the large incisors are very similar to those of rodents. The skeleton resembles that of the carnivores.

THE PRIMATES, INCLUDING MAN.

We come now to the highest group of mammals, the primates, which include the lemurs, the apes, and man. This order has a great antiquity, and even at the base of the eocene, we find it represented by several genera belonging to the lower forms of the group. In considering these interesting fossils, it is important to have in mind that the lemurs, which are usually regarded as primates, although at the bottom of the scale, are only found at the present day in Madagascar and the adjacent regions of the globe. All the American monkeys, moreover, belong to one group, much above the lemurs, while the Old World apes are higher still, and most nearly approach man.

In the lower eocene of New Mexico, we find a few representatives of the earliest known primates, and among them are the genera *lemuravus* and *limnotherium*, each the type of a distinct family. These genera became very abundant in the middle eocene of the West, and with them are found many others, all, however, included in the two families, *lemuravidæ* and *limnotheridæ*.

In the miocene lake basins of the West, only a single species of the *primates* have been identified with certainty. This was found in the oreodon beds of Nebraska, and belongs to the genus *laopithecus*, apparently related both to *limnotheridæ* and to some existing South American monkeys. In the pliocene and post-pliocene of North America, no remains of primates have yet been found.

In the post-pliocene deposits of the Brazilian caves, remains of monkeys are numerous, and mainly belong to extinct species of *callithriæ*, *cebus* and *jacchus*, all living South American genera. Only one extinct genus, *protopithecus*, which embraced animals of large size, has been found in this peculiar fauna.

It is a noteworthy fact, that no traces of any anthropoid apes, or indeed of any Old World monkeys, have yet been detected in America. Man, however, the highest of the primates, has left his bones and his works from the Arctic Circle to Patagonia. Most of these specimens are clearly post-tertiary, although there is considerable evidence pointing to the existence of man in our pliocene. All the remains yet discovered belong to the well marked genus *homo*, and apparently to a single species, at present represented by the American Indian.

RELATION OF SUCCESSIVE GROUPS.

In this rapid review of mammalian life in America, from its first known appearance in the trias down to the present time, I have endeavored to state briefly the introduction and succession of the principal forms in each natural group. If time permitted, I might attempt the more difficult task of trying to indicate what relations these various groups may possibly bear to each other; what connection the ancient mammals of this continent have with the corresponding fauna of the Old World; and, most important of all, what real progress mammalian life has here made since the beginning of the eocene. As it is, I can only say, in summing up, that the marsupials are clearly the remnants of a very ancient fauna, which occupied this continent millions of years ago, and from which the other mammals were doubtless all derived, although the direct evidence of the transformation is wanting.

The relations of the American primates, extinct and recent, to those of the other hemisphere, offer an inviting topic, but it is not in my present province to discuss them in their most suggestive phases. As we have here the oldest and most generalized members of the group, so far as now known, we may justly claim America for the birth-place of the order. That the development did not continue here until it culminated in man, was due to causes which at present we can only surmise, although the genealogy of other surviving groups gives some data towards a solution. Why the Old World apes, when differentiated, did not come to the land of their earlier ancestry, is readily explained by the then intervening oceans, which likewise were a barrier to the return of the horse and rhinoceros.

REMAINS OF MAN ON THIS CONTINENT.

Man, however, came; doubtless first across Behring's Straits; and at his advent became part of our fauna, as a mammal and primate. In these relations alone it is my purpose here to treat him. The evidence, as it stands to-day, although not conclusive, seems to place the first appearance of man in this country in the pliocene, and the best proof of this has been found on the Pacific coast. During several visits to that region many facts were brought to my knowledge which render this more than probable. Man at this time was a savage, and was doubtless forced by the great volcanic outbreaks to continue his migration. This was at first to the south, since mountain chains were barriers on the east. As the native horses of American were now all extinct, and as the early man did not bring the Old World animal with him, his migrations were slow. I believe, moreover, that his slow progress toward civilization was in no small degree due to this same cause, the absence of the horse.

It is far from my intention to add to the many theories extant in regard to the early civilization in this country, and their connections with the primitive inhabitants or the later Indians, but two or three facts have lately come to my knowledge which I think worth mentioning in this connection. On the Columbia River I found evidence of the former existence of inhabitants much superior to the Indians at present there, and of which no tradition remains. Among many stone carvings which I saw there were a number of heads, which so strongly resemble those of apes that the likeness at once suggests itself. Whence came these sculptures, and by whom were they made? Another fact that has interested me very much is the strong resemblance between the skulls of the typical mound-builders of the Mississippi Valley and those of the Pueblo Indians. I had long been familiar with the former, and, when I recently saw the latter, it required the positive assurance of a friend who had

himself collected them in New Mexico to convince me that they were not from the mounds. A third fact, and I leave man to the archæologists, on whose province I am even now trenching. In a large collection of mound-builders' pottery, over a thousand specimens, which I have recently examined with some care, I found many pieces of elaborate workmanship so nearly like the ancient water-jars from Peru that no one could fairly doubt that some intercourse had taken place between the widely-separated people that made them.

The oldest known remains of man on this continent differ in no important characters from the bones of the typical Indian, although in some minor details they indicate a much more primitive race. These early remains, some of which are true fossils, resemble much more closely the corresponding parts of the highest Old World apes than do the latter our tertiary primates, or even the recent American monkeys. Various living and fossil forms of Old World primates fill up essentially the latter gap. The lesser gap between the primitive man of America and the anthropoid apes is partially closed by still lower forms of men, and doubtless also changes in the environment migrations are enforced, slowly in some cases, rapidly in others, and with change of locality must come adaptation to new conditions or extinction. The life history of tertiary mammals illustrates this principle at every stage, and no other explanation meets the facts.

The real progress of mammalian life in America, from the beginning of the tertiary to the present, is well illustrated by the brain-growth, in which we have the key to many other changes. The earliest known tertiary mammals all had very small brains, and in some forms this organ was proportionately less than in certain reptiles. There was a gradual increase in the size of the brain during this period, and it is interesting to find that this growth was mainly confined to the cerebral hemispheres or higher portion of the brain. In most groups of mammals the brain has gradually become more converted, and thus increased in quality as well as quantity. In some, also, the cerebellum and olfactory lobes, the lower parts of the brain, have even diminished in size. In the long struggle for existence during tertiary time the big brains won, then as now; and the increasing power thus at least, of a premolar to the molar series, and a gradual lengthening of the crown. Hence, it is often easy to decide from a fragment of a jaw to what horizon of a tertiary it belonged. The fossil horses of this period, for example, gained a grinding tooth for each toe they lost, one in each epoch. In the single-toed existing horses all the premolars are like the molars, and the process is at an end. Other dental transformations are of equal interest, but this illustration must suffice.

The changes in the limbs and feet of mammals during the same period were quite as marked. The foot of the primitive mammal was doubtless plantigrade, and certainly five-toed. Many of the early tertiary forms show this feature, which is still seen in some existing forms. This generalized foot became modified by the gradual loss of the outer toes, and increase in size of the central ones; the reduction proceeding according to systematic methods, differing in each group. Corresponding changes took place in the limb bones. One result was a great increase in speed, as the power was applied so as to act only in the plane of motion. The best effect of

DESIGN FOR BOOK COVER. FROM THE STUDIO OF THE ART INDUSTRY MUSEUM, LEIPZIG. EXECUTED BY G. FRITZSCHE, BOOKBINDER.—*From the Workshop.*

by higher apes, now extinct. Analogy, and many facts as well, indicate that this gap was smaller in the past. It certainly is becoming wider now with every generation, for the lowest races of men will soon become extinct, like the Tasmanians, and the highest apes cannot long survive. Hence the intermediate forms of the past, if any there were, become of still greater importance. For such missing links we must look to the caves and later tertiary of Africa, which I regard as now the most promising field for exploration in the Old World. America, even the tropics, can promise no such inducements to ambitious explorers. We have, however, an equally important field, if less attractive, in the cretaceous mammals, which must have left their remains somewhere on the continent. In these two directions, as I believe, lie the most important future discoveries in palæontology.

As a cause for many changes of structure in mammals during the tertiary and post tertiary, I regard, as the most potent, *Natural Selection*, in the broad sense in which that term is now used by American evolutionists. Under this head I include not merely a Malthusian struggle for life among the animals themselves, but the equally important contest with the elements and all surrounding nature. By gained rendered useless many structures inherited from primitive ancestors, but no longer adapted to the new conditions.

Another of the interesting changes in mammals during tertiary time was in the teeth, which were gradually modified with other parts of the structure. The primitive form of tooth was clearly a cone, and all others are derived from this. All classes of vertebrates below mammals, namely, fishes, amphibians, reptiles, and birds, have conical teeth, if any, or some simple modification of this form. The edentates and cetaceans with teeth retain this type, except the zeuglodonts, which approach the dentition of aquatic carnivores. In the higher mammals the incisors and canines retain the conical shape, and the premolars have only in part been transformed. The latter gradually change to the more complicated molar pattern, and hence are not reduced molars, but transition forms from the cone to more complex types. Most of the early tertiary mammals had forty-four teeth, and in the oldest forms the premolars were all unlike the molars; while the crowns were short, covered with enamel and without cement. Each stage of progress in differentiation of the animal was, as a rule, marked by a change in the teeth; one of the most common being the transfer, in form this specialization is seen to-day in the horse and antelope, each representing a distinct group of ungulates, with five-toed ancestors.

If the history of American mammals, as I have briefly sketched it, seems, as a whole, complete and unsatisfactory, we must remember that the genealogical tree of this class has its trunk and larger limbs concealed beneath the *débris* of mesozoic time, while its roots doubtless strike so deeply into the palæozoic that for the present they are lost. A decade or two hence we shall probably know something of the mammalian fauna of the cretaceous, and the earlier lineage of our existing mammals can then be traced with more certainty.

The results I have presented to you are mainly derived from personal observation; and since a large part of the higher vertebrate remains found in this country have passed through my hands, I am willing to assume full responsibility for my presentation of the subject.

For our present knowledge of the extinct mammals, birds, and reptiles of North America, science is especially indebted to Leidy, whose careful, conscientious work had laid a secure foundation for our vertebrate palæontology. The energy of Cope has brought to notice many strange forms and greatly enlarged our literature. Agassiz, Owen, Wyman,

Baird, Hitchcock, Deane, Emmons, Lea, Allen, Gibbes, Jefferson, DeKay, and Harlan deserve honorable mention in the history of this branch of the science. The South American extinct vertebrates have been described by Land, Owen, Burmeister, Gervais, Huxley, Flower, Desmarest, Aymard, Pictet, and Nodot. Darwin and Wallace have likewise contributed valuable information on this subject as they have on nearly all forms of life.

In this long history of ancient life I have said nothing of what life itself really is. And for the best of reasons, because I know nothing. Here at present our ignorance is dense, and yet we need not despair. Light, heat, electricity, and magnetism, chemical affinity and motion are now considered different forms of the same force; and the opinion is rapidly gaining ground that life, or vital force, is only another phase of the same power. Possibly the great mystery of life may thus be solved, but whether it be or not, a true faith in science admits no limit to its search for truth.

WROUGHT IRON BALCONIES FROM VENICE AND MILAN. DRAWINGS OF PROF. MYSKOVSZKY.—*From the Workshop.*

OCTOPUS FISHING IN JAPAN.

WITH bodies blackened by the sun to the color of the seaweed, the Japanese fishermen are incommoded by neither the rain nor the winds. Like the fishermen of all lands, their restless eyes were wandering from the sea to the heavens. With no guides but the stars by night and the blue edge of the land by day, there was no need for keen eyesight and watchfulness. In all the Eastern seas there is no more adventurous race than these men.

We could see the floats of burnt wood which buoyed the ends of our fishermen's lines, and to the nearest of these we were sculled. A kind of wood, light and buoyant, and with some resemblance to cork, is used for such floats. It grows in the forests thereabouts, and, after being shaped and charred to prevent decay, lasts, without further trouble, for a longer time than bladders or skins. With some impatience the black buoy and the line attached are brought on board. Like an inverted bell-shaped flower pot comes the first earthenware jar, hardly the size of a child's head, attached to the line. Mouth downward, the jar is pulled up from the bottom, and when all the water has been poured out, the fishermen give a look inside. No occupant being found, the jar is once more lowered into the sea by the attached strings, which is overrun until the next jar is pulled up, brought on board, and similarly examined. When six or seven are examined, and no occupant is found in any of these, the fishermen show no impatience. But presently from a jar an octopus is jerked upon the floor of the boat, and with some satisfaction the Japanese watch its tentacles wriggle all about the planks and cling round their legs. Changing its hues, the disgusting cephalopod loses its redder blotches for paler patches, and eventually crawls into a darker corner to coil itself away. Pouring the water more carefully from the inverted pots, the fishermen secure a few more of these animals, which crawl and twine about with snakelike contortions. The long string of pots took time to overhaul, but the spoils were reckoned reward for the trouble. When the fishing was completed, and the black floats were again left to mark the spot, our boat was sculled somewhat further down the land.

We had time to learn something more of this fishing for tako, as the octopus is named by the Japanese fishermen. Through our friends, we learn that the tako needs no bait to entice it into the earthen jars used by the fishermen to entrap it; but crawling about on the bottom, or shooting itself through the sea by the expulsion of water, it finds in the dark, earthen jar "a comfortable house," and so occupies it until the fisherman finds and captures it. The tako is largely eaten in Japan, where all the products of the sea are accounted equally wholesome with those of the land; and beneath an ugly skin the flesh of this speckled monster is thought very good, cooked in several ways, and eaten with or without soy or vinegar. Nevertheless, as if to vindicate the dread its constantly changing hues excite, the eating of the octopus is not unattended with danger. Through some poisonous taint, either occasionally or always present, but modified by the process of cooking, people sometimes die from eating this animal. And yet the knowledge of this interferes but to a trifling extent with the use of food having such a questionable reputation—indeed, at certain seasons, it is largely used by the Japanese, when the cuttle fish are far more plentiful and also more wholesome. Caught by trolling a small wooden fish barbed with hooks, they make good sport, chiefly to the older fishermen, who are not active enough to go off to sea.—*Chambers' Journal.*

RED WATER IN LONG ISLAND SOUND.

IT is possible that the red appearance in the water, observed near Gull Island recently, was due to the presence in vast numbers of the little pteropod *Clio borealis*, for this little animal is said by De Kay in the Mollusca of New York to have been observed occasionally in great numbers in our bays. In April, 1833, they were very abundant and of a blood-red color; after a few days they all disappeared. A few individuals were seen in the water off Napatree Point, R. I., by Professor Verrill and myself in April, 1877. But it seems more probable to me that the color was caused by a minute seaweed or alga of the genus *Trichodesmium* of Ehrenberg. Two species are known, *Tr. erythæum*, which Dr. Montague (in *Ann. de Science Naturelle*, December, 1844, p. 347) considers the cause of the red color in the waters of the Red Sea, and *Tr. Hindsii*, which has been noticed in the waters off the shores of Brazil and near the coast of California. Both are exceeding minute plants, consisting of little jointed blood-red threads about one-twelfth of an inch long and one four hundredths of an inch thick, many threads gathered in a little bunch, and involved in jelly. Should the phenomenon be observed again I should be very glad if the observer would dip a piece of paper in the reddened water, and after drying it in the air send it to me for examination.—*Professor D. C. Eaton, in the New Haven Palladium.*

THE FALL OF A MOUNTAIN IN SAVOY.

AN interesting account of the recent falling of a mountain in Tarentaise, Savoy, causing disaster to two flourishing villages, has been communicated to the *Courrier des Alpes* by M. Bérard. The phenomenon has been incorrectly reported as instantaneous and the destructive effect complete, whereas the case is that of a mountain which for twenty days, without cessation, has been dismembering itself and literally falling, night and day, into the valley below, filling it with piled up blocks of stone, extinguishing all sounds by its incessant thunder, and covering the distant horizon with a thick cloud of yellowish dust. The entire mass comprised in the slope forms a mutilated cone 200 metres broad at the top and 600 at the base (the slope being about 50 degrees); this is composed of hard schist lying close together, but no longer united; and it is united to the body of the mountain only by a vertical mass of 40 or 50 metres thick, which already is fissured and shaken. Periods of repose occur lasting only a few seconds, or a minute at most; then the movement recommences, and continues about 500 hours. Blocks of 40 cubic metres become displaced with no apparent cause, traverse the 1,800 metres of descent in thirty seconds, leaping 400 or 500 metres at a time, and finally get dashed to pieces in the bed of the torrent, or launch their shattered fragments into the opposite forest, mowing down gigantic pines as if they were so many thistles. One such block was seen to strike a fine fir-tree before reaching the bridge between the villages; the tree was not simply broken or overthrown, but was crushed to dust (*volatilisé*); trunk and branches disappeared in the air like a burning match. Rocks are hurled together and broken into fragments that are thrown across the valley like swallows in a whirlwind; then follow showers of small fragments, and one hears the whistling sound of thousands of pebbles as they pass. M. Bérard reached the edge of the rock (2,460 metres high,) on one of the sides of the falling cone, and ventured along it, obtaining a good view of the "terrifying" spectacle. He reaffirms his conviction that the phenomenon is unexplicable by any of the usual reasons that account for Alpine disturbances, such as penetration of water, or melting of snows or inferior strata in motion; nor does the declivity of the slope explain it. His hypothesis is that some geological force is at work, of which the complex resultant acts obliquely to the axis of the mountain and almost parallel to its sides.—*Nature.*

THE CREDIT SIDE OF THE INSECT ACCOUNT.

WE have referred more than once in this journal to the mischief done by insects, but only on one occasion, we believe, to our indebtedness to them. In an article which appeared in the medical department some months ago, the therapeutical value of cantharides, or "Spanish flies," was duly set forth. It was stated, indeed, that chemical and medical science had not succeeded in finding any vesicating agent that could perfectly replace these insects. It may be added, in illustration of their extensive use and their commercial importance, that 12 tons of them have been shipped in a single year from the Island of Sicily alone.

The cochineal insect is another of no slight industrial value, though the coal-tar colors in these latter days have largely superseded it as a dyestuff. It still, however, furnishes the pharmacist with the coloring matter for his tinctures.

Nutgalls afford another illustration of the uses of insects in the arts and in medicine. Enormous quantities are consumed in dyeing and the manufacture of inks. Gallic and pyrogallic acids are indispensable to the photographer. The annual yield of galls in Persia alone averages more than 2,000 tons, and that of Turkey is about the same.

On our debt to the bee for honey and wax it is unnecessary to enlarge, and what we owe to the silkworm is equally familiar. Silk, indeed, is one of those unique products for which no adequate substitute has ever been found. It is also one for which the demand is constant from year to year and from century to century. Silk has been a popular fabric from ancient times, and is likely to remain independent of the caprices and mutations of fashion. The cast-off shroud of a worm will continue to be, as for ages it has been, the favorite material for the dress of women and for many purposes of household adornment.

Even the husbandman can allow something to be credited to these creatures which cause him so much labor and loss. Insects have many enemies among their own kindred, and the multiplication of some species is kept within proper limits by the hostility of others. The ichneumon flies, the lace-winged flies, and the lady bugs are thus good friends to the farmer and the gardener. A wolf in a sheepfold would be comparatively less destructive than a lady-bug or the larva of a lace-winged fly among a colony of aphides or plant-lice. While such insects are directly beneficial, others that at first seem to be unmitigated pests may nevertheless be indirectly useful. Insects make up for their individual insignificance by the aggregate potency of numbers. Countless myriads of gnats, in such clouds as to appal the traveler, and numberless other tribes that also annoy us, may be useful as manure; for, as the researches of John Davy have shown, insects convert vegetable matters into nitrogenous compounds, and are thus so many laboratories of guano. Hence the marvelous prodigality of insect life and death in tropical forests may be one cause of the luxuriance of vegetation there. Even the worst of our domestic pests have a meaning as monitors of the necessity of a vigilant cleanliness and ventilation for our health and existence. One writer, indeed, has raised the curious question how far some great fevers and other plagues, centuries since, might have

been indirectly prevented by the effect, in this manner, of certain species of bugs, had they then existed in such numbers as nowadays.

Upon the whole, notwithstanding all the wailing about insect depredations, more lamentation would ensue were the entire insect world destroyed than has ever been caused by their ravages. Insects have long been food for some races of men, and some has said that if we will not eat them we have no right to complain of their increase and their mischief. St. John is good biblical authority for utilizing locusts as an article of diet; and the experiments made in Missouri, two or three years ago, proved that locusts may well be eaten. At least no one need starve after the locusts have eaten up his crops if he will devour the voracious insect in turn. They are nutritious and not bad in flavor, "tasting something between meat and fish" when mixed with a little oil and browned over the fire.

To sum up, to insects we owe wax and honey, silks and precious dyes, valuable medicines, food for birds and many other animals, the fertilization and increase of plants necessary for the subsistence of many creatures, and thus, indirectly, for the preservation of man. In short, the human species, wholly deprived of the services of insects, would fade from the face of our planet. So the husbandman has only to make the best of it by learning to distinguish between his friends and his foes, and how to assist the beneficent operations of nature in encouraging the former and checking the latter.—*Boston Journal of Chemistry.*

POT-GROWN STRAWBERRIES.

By F. R. PIERSON.

THE strawberry has been called the "Queen of Fruits," ushering in as it does the first fruit of the year. No pen is needed to laud its merits or to sustain its claim to this distinction; it speaks of itself, and a dish of ripe luscious berries appeals to one's inner consciousness as nothing else can. Growing wild naturally in the field, and doing well when given only ordinary culture, and left to struggle with weeds, etc. (they are more often left than otherwise), they more than repay extra culture; in fact the large finer sorts will not do well when left to grow as they will, and, to succeed at all, must have culture. Berries can be grown from one to two ounces in weight, often a quart to the plant, as easily as small sour Wilsons can be grown, and much more satisfactorily. A small bed of 300 plants set out last fall for home use yielded enormously this spring. By planting early, say from August 1st to September 20th, a full crop can be obtained in 9 or 10 months, but to accomplish this result, the young plants which are to be set out must be potted, as ordinary "ground layers," as they are termed by florists, would not live planted at this time of year. The weather is too hot and dry, and there would hardly be a chance of 50 per cent. growing, while by using potted plants not one should be lost.

To prepare the plants, take small pots (two inch are best) and sink them into the earth beneath a young runner or plant which has started from the old plants, fill the pot with soil, bring the runner just over it, placing stones upon it to keep it in place, and in two or three weeks the young plant will be found to be sufficiently rooted to be removed from the pot, without being disturbed in the least. This is a simple operation, and can be easily done by any one; but where only a few are wanted, or there are no pots convenient, they can be obtained from those who make a speciality of raising just such plants. They are sold for $3 per hundred—only double the cost of ground layers—and many would find this the best way. The bed should be prepared by spading down two or three inches of thoroughly rotted cow manure, when it can be had, but when not, any other will do, provided it is well rotted, digging it well into the bed as deep as possible, and thoroughly incorporating it with soil. The plants should be set in rows two feet apart, the plants eighteen inches apart in the row; or if the ground is limited, a foot apart will do. The ground should now be kept thoroughly stirred up by frequent hoeings, and all runners removed as fast as they make their appearance, as they weaken the plants, thus lessening the crops of fruit. Farther than this, nothing is necessary until severe cold weather sets in, and the ground freezes up. The plants should then be covered with about two inches of salt hay, leaves or grass; but salt hay is best where it can be had. This protects the plants from the frost, afterwards keeps the berries free from earth, prevents weeds growing, and also the soil from drying out, and is one of the most important factors in successful berry culture.

By March the plants will need looking after, and as soon as there are signs of thawing, the mulch should be pushed aside slightly from the crown of each plant, to give it light and air, and to enable it to push through. Of course it will be understood that the mulch is still left on until after the fruit is picked. It is then removed, manure spread between the rows and forked in, and all runners still kept from growing. For most families 200 plants would be sufficient, and planted from pot-grown runners in August or September, would probably yield 100 quarts per annum. A bed will last two years, and bear abundantly, but we find it should be renewed as often as this, as young plants bear finer and larger fruit.

There are an endless number of varieties, bewildering to the uninitiated. I would not advise any one to plant one sort only, as by planting three or four varieties—early, medium and late—the season can be lengthened about two weeks a great desideratum. The following I consider best as regards size, productiveness and quality: For early, Charles Downing, a good-sized berry, and a most abundant bearer, but Seth Boyden (or Boyden's No. 30), an immense berry and very productive, carries off the prize for size, and is exceedingly popular. Monarch of the West is also another very large berry—larger if anything than the preceding. Some complain that it does not ripen to the tip, but if left on the plant sufficiently long, it will ripen perfectly. Kerr's Late Prolific is the best late sort, and is well entitled to the name Prolific. In size it is medium, yet is desirable on account of its lateness. Triomphe de Gand and Jucunda are both well known, doing splendidly on heavy soil, but almost worthless on light soil. These are standard sorts, and will be found to be more than satisfactory. The Great American, introduced last year, is probably the best strawberry ever sent out, but being new, is consequently high priced. It is a beautiful berry, exceedingly large, weighing frequently two ounces each. It took the first premium at the Centennial for the best and largest variety exhibited.—*Country Gentleman.*

CHESTNUT SEEDLINGS.—A writer in the *Western Rural* gives the method by which he raised 3,000 trees from seed procured fresh from the burr the previous autumn. They were placed in a goods-box in the cellar, in alternate layers with moss, scattering the chestnuts on the layers of moss so that none came in contact with each other, the moss being slightly damp. Early in spring, the nuts had sprouted, the moss adhering to the long fibrous roots. This was planted with them. For good success afterwards the soil must be high, dry, and not tenacious and wet. All these seeds grew, and gave more trees than nuts, some being double.

RECLAIMED SALT MARSHES.

By W. CLIFT, Mystic Bridge, Conn.

HAVING successfully reclaimed a salt marsh some twenty years ago, and observed the operation of others along the sea cost, I give others who desire to make the improvement the benefit of my experience and observation. Reclaimed salt marshes, properly treated, are unquestionably among the best grass lands in our seaboard towns, and we hail with great satisfaction all attempts to improve them.

The general impression is, after the sea water has been shut out, that they must be plowed and cultivated like other lands, in order to bring them into meadow or pasture. But plowing is not necessary, and rather hinders than helps the improvement. The sod of such marshes as are frequently flowed by the tide is exceedingly tough and untractable, as all have learned who have attempted to subdue it with the plow and the harrow. It is from six inches to a foot in thickness, a spongy mass of tough roots, which, dried and packed in an embankment, or sod fence, will last many years. The best and quickest way to get good grass from this sod is by surface treatment.

Drain Thoroughly.—A broad border ditch should surround the reclaimed marsh, broad and deep enough to serve the purpose of a fence, and to carry off rapidly all the water that falls upon it. The number of ditches that will be required to carry off the surface water will depend upon the fall that can be had from the flow of the tide. In some localities the difference between high and low water in ordinary tides is only two or three feet, in others six feet or more. With facilities for draining a marsh four or five feet deep, fewer ditches will be required than where only two feet fall can be had. The sod is so tough that surface drains will last many years. These drains may be cut eight inches wide, and two or more feet deep, and should run from one border ditch into the other. If the reclaimed land is designed for mowing, the outlet of these narrow ditches may be bridged for a rod or more with common two-inch round or sole tile. Lay the tile upon strips of board at the bottom of the ditch, and fill in with the earth that was taken out, and replace the sod at the top. With these bridges at the ends of the drains, there will be no obstruction to the horse-mower. It will be safe to make these narrow ditches four rods apart; and if that does not give sufficient drainage, they can be increased afterwards. The narrow ditches will not interfere at all with the pasturage of cattle, and a very little attention every spring will keep them in good order.

Result of Shutting Out the Tide.—The result of shutting off sea water will be a great increase in the growth of the marsh grasses, and a gradual change to upland grasses. These marine grasses lose much of their saltness the first season; the hay that is made from them is eaten with as much avidity as upland hay. Stock thrive upon it, and it makes good milk. The first indication of a change of products will probably be scattering specimens of dock, dandelions, thistles or other weeds, whose seeds have been left upon the surface by the flow of fresh water streams or the tides. If the marsh has received a fresh water stream to deposit grass seed, there may be scattering blades of grass the first season after the tide gate is put in. But we should not expect much change until the second year. It is not, however, worth while to wait for the operation of natural causes to change the vegetation.

Sow the grass seed either in the fall or spring, the next season after the tides have been shut out. If this were done immediately after the exclusion of the sea water, much of the seed would probably be lost; but, after six months of exposure to the new conditions, the catch will be as good as upon upland. After the tide gate is put in, every rain that falls, and all the water from brooks that flow through, carries off a portion of salt. In a few months, the water in the ditches becomes potable. The surface is a soft, spongy mass, in which seeds strike root readily, and grow luxuriantly. The cultivated grasses will gradually run out the old growth and form a new sod.

Top-dressing.—We tried several experiments in top-dressing the reclaimed land. Some was dressed with stable manure, some with surface mould taken from an old garden, and some with gravel. The sand and gravel, a very thin coating, improved the yield of grass and paid for the labor. The garden soil made a still better crop, and paid still better. The manure was a much more expensive application and yielding larger crops, but whether it was more economical than the garden soil is questionable. The drainage brings a large mass of plant food, some two or three feet in depth, within reach of the grass roots, which will last a great many years.

Management.—It is quite evident that the dyking and draining of these marshes will pay abundantly, if nothing more be done to them. It may safely be calculated that the hay will be doubled in quantity, and that one ton of the sweet hay will be worth as much as three tons of the salt for fodder.

Whether it will be desirable to do anything more than this, will depend somewhat upon the location of the marsh in reference to the market, and the amount of capital at the command of the owner. If the marsh is at a distance from the barn, and from a good market, it may be the best thing to do nothing more than sow grass seed, and use it for pasture. It will be found to give a good bite of grass earlier in the spring than the upland, and to hold later in the fall. But in case of marshes conveniently situated, it will be a safe investment of capital to make farther improvements.

Not more than a ton and a half of hay can be expected without top-dressing of some kind. With top-dressing they can be made to yield three to four tons to the acre, beside a large crop of afterfeed. Almost any kind of gravel, sand or loam from the adjacent uplands will be found to increase the yield, even if it is not spread more than a half an inch in depth. A compost of loam, or muck and manure, will do much better. Oyster shell lime is a valuable dressing, and where this article can be had cheaply, as is generally the case in the vicinity of large cities, it will be one of the cheapest amendments. Wood ashes are valuable, but quite too scarce and dear to be available. Hard coal ashes will pay for carting a mile or two, where they can be had for the gathering in the villages and cities. It should not be thought a hardship to do something for land that yields so abundantly. We are continually plowing, manuring and stocking our upland meadows to make them yield a ton and a half to the acre, and is much beyond the average. The dyked marsh, with a much less outlay, will yield a far more remunerative crop.

It is well known that these salt marshes, saved from the sea in the north of Europe, are among the richest and most productive in the world, and now support a vast population. In 1872 and 1873 the large marsh on Green River Harbor in Marshfield, Mass., embracing over 1,400 acres, was reclaimed, and is yielding satisfactory crops. Almost every sea-board town along the Atlantic coast has marsh land, and in the aggregate there are hundreds of thousands of acres (now of little value) that can be reclaimed, and pay large dividends on the investment.

THE CATERPILLAR CURE.

AN ingenious instrument for cleansing trees of caterpillars has been invented by a M. Damanian, of Rozière, near Sainte Foy-la-Grands, Gironde, France, and which, after a careful trial by the engineer-in-chief in charge of the public thoroughfares in the Department of the Seine, has been adopted by the French Minister of Public Works. The instrument consists of a brass tube about 4 ft. long and 1 in. in diameter, inclosing another of the same length, which is worked by telescopic action. To one end of this an india rubber tube of equal length, with a mouthpiece, is affixed; and at the opposite end is a small brass receptacle for oil, with a fine spray nozzle. Petroleum, being the most deadly liquid known for the destruction of caterpillars, is preferred to all other oils for use in this instrument, through which it is blown in the form of a dense fine spray on the nests of the insects causing immediate destruction to them without injuring the trees.

GROWING CHESTNUTS FROM SEED.

MR. J. S. BUDD thus gives his experience to the *Western Rural*: "In 1871 I grew about 3,000 trees from seed procured the previous fall, perfectly fresh in their burr. As soon as received I hulled them in a common dry-goods box in my cellar, with alternate layers of moss, such as is used for packing plants for shipment, scattering the chestnuts on the moss so as not to come in contact with each other. The moss should be but slightly damp, and if the surface becomes very dry during the winter, it may be sprinkled, but the moss need not be disturbed until planting time in the spring, say the 10th or 15th of April. The nuts by this time have nicely sprouted. Long roots will be attached to the moss and adhering firmly to the fibers. This should be allowed to remain and be planted with them, and should the season be dry, the moss will be rather a benefit than otherwise by retaining moisture about the root. From nuts treated in this way I grew more trees than I planted nuts, as some have double kernels, and produce two trees.

"I planted in drills, four inches apart in the drills, and sufficient space between the drills to use a small garden hoe, the whole occupying less than one-square rod, affording a good profit at an average price of $3 per hundred, when sold in the fall. I have trees eight years old, grown from seed in the above manner, that bore nuts at the age of five years, and at eight years produced a peck of hulled nuts.

"The soil and situation in which to grow the chestnut is all-important. They flourish best on high, dry situations, or on rolling, well drained silicious soil, but are impatient of much wet, or low, tenacious localities."

ASTRONOMY.

Opposition of Mars.—Advantage will be taken by several observers of the approaching favorable opposition of Mars for a new determination of the solar parallax, by observing the diurnal parallax of the planet. It is to be hoped that the old method, which Kepler attempted to apply to Tycho Brahe's observations, and which was first tried with some degree of success by Cassini and by Flamsteed in the year 1672, will yield satisfactory results when superior modern instruments are properly employed at suitable stations. Mr. Pogson has expressed his intention of making such observations by means of the equatoreal of the Madras Observatory; and, more promising still, under the auspices of the Royal Astronomical Society, Mr. Gill has left England for the Island of Ascension for the special purpose of making the requisite observations by means of Lord Lindsay's heliometer, kindly lent for the occasion. Nearly half a century ago, on the occasion of the opposition of 1830, Olbers expressed his wish that the heliometer might be used for such purpose, as in his opinion the solar parallax could be determined in that way "fully as accurately" as by means of the transits of Venus. At last, then, the old wish of Olbers is on the point of being realized. Besides Mars, Mr. Gill intends to observe also some of the minor plants for the same purpose. The favorable opportunity will not be neglected for physical observations of the surface of Mars. Past experience has sufficiently shown that for these observations a very large telescope is far less essential than a skillful and experienced draughtsman and a pure and transparent atmosphere. It is, therefore, satisfactory to learn that Mr. Green, who has given proofs of his skill in that special branch of work, is going to the fine climate of Madeira, taking with him an excellent reflector for the special purpose of making sketches of Mars.

Saturn, near its bright neighbor Mars, will appear fainter than usual, as the ring is now a very narrow ellipse. The disappearance and reappearance of the ring in February next will scarcely be observable, the planet being then too near the sun, and the circumstances will not be more favorable at at the next similar occasion in the autumn of 1891, so that observers must wait till the year 1906 before they can observe the phenomena connected with the disappearance and reappearance of the ring to advantage. Saturn is, however, during the ensuing apparition in an interesting and favorable position for observations of its satellites, since their apparent orbits are very flat ellipses, and their conjunctions with the ends of the ring and with the limbs of the ball can be observed with considerable accuracy, without the need of a micrometer.—*Academy.*

A CURIOUS GLOBE.

A MONK of the Benedictine monastery at Raigern, between Brünn and Vienna, has completed a mechanical curiosity in the shape of a self-moving terrestrial globe, 4½ feet in diameter. A combination of wheels gives it a motion similar to that of the earth, and when once set going it will revolve

for three weeks. At the north pole of the axis are dial-plates, on which the days, months, etc., are indicated, and over these is a smaller globe, by means of which the motion of our planet round the sun is exhibited. The larger globe sets the smaller one in motion by the agency of twelve wheels. The construction of the mechanism took more than ten years' patient application, and was only completed after numerous experiments. As regards geographical details, the map on the globe is carefully drawn, and shows all the latest discoveries. The steamer routes, railway and telegraph lines, the heights of mountains, and the depths of the ocean are all distinctly shown. By a somewhat odd conceit, the year in which the globe was begun (1866) can be ascertained by a rearrangement of certain letters of the Benedictines' motto inscribed on it:—"In hoc, sicut in omnibus, glorificetur Deus." The maker of the globe is a self-taught mechanician and artist, who, during the past thirty years, has adorned the monastery with numerous examples of his skill and ingenuity.

A METEORITE 1,500 FEET IN DIAMETER.

THE STÄLLDALEN METEORITE.*

In the Scandinavian North, so extraordinarily rich in mines and quarries, there have been found during the last few years a number of new minerals, by which many a mine and even many an inconsiderable opening scarce known in its own parish has become world-famous in mineralogical literature. Several of these *finds* are of great interest in a systematic aspect—for instance, the discovery of *barytite*, a new, exceedingly basic variety of felspar containing baryta; of *ganomalite*, the first natural silicate of lead which has been discovered; of *ekdemite*, a new mineral containing antimonic acid, from the mines of Langban; and of *homilite*, a new, beautifully crystallized silicate of boron, containing water, from Brevig. Others again give us a highly unexpected insight into the nature of the chemical forces which are in activity in the interior of the earth—for instance, the Wermland minerals, *manganosite*, or protoxide of manganese, and *pyrokroite*, or hydrated protoxide of manganese, which afford evidence of a powerful reducing action. The latter mineral has during the last year been found at a new locality—the mines of Nordmark.

However important these newly discovered minerals may be, they do not awaken so keen an interest as the stones which from time to time fall from the heavens, and afford us specimens of the matter to be found in spaces so remote that rays of light require thousands of years to reach them. A new and highly instructive contribution to our knowledge of meteorites has been obtained in Sweden through the fall of the meteorite, which took place at Ställdalen, near Nya Kopparberg, in Orebrolän, on June 28, 1876, at 11:30 A. M., from a fire-ball which was visible over a large part of middle Sweden. In the neighborhood of Stockholm the meteor appeared as an indistinctly-defined fire ball, followed by a long streak of fire. The ball was first visible below the zenith in the northeast or north northeast, and went from hence toward the horizon in the west, where it generally appeared to fall in the immediate neighborhood of the spectator, sometimes with, sometimes without, the throwing out of sparks. In the town of Gefle the fire red ball, followed by a streak of the same color, was seen moving from northeast to southwest. At the neighboring promontory, Harnäs, it was first seen of the size of a large star, speedily increasing, however, leaving a long streak of fire behind it, and finally disappearing without noise, falling, according to the supposition of the spectator, behind some neighboring buildings.

At Malmköping the meteor appeared to proceed from the northern heavens toward the west, leaving behind it a fine white streak, which was distinguishable for two minutes. At a height of 25° above the horizon it disappeared without falling asunder. At Linköping the nucleus of the meteor was pear-shaped, of blinding whiteness, followed by a streak of fire which was strongly luminous notwithstanding the clear bright sunshine, and about eight times longer than the nucleus. It was first observed pretty high up in the northeast, but afterward sank to a height of 10° above the horizon in the west, where it broke up without noise into a number of star-sparks. In Skara the meteor, followed by a beautifully luminous streak of fire, appeared to fall asunder, throwing out sparks strongly at the same time, after having gone from east to west with an apparent diameter of half that of the moon. In Hedemora two fire-balls were seen, one close behind the other, falling from the zenith toward the west, leaving behind them a light gray streak. A minute after the meteor passed from the field of view a loud explosion was heard, which is also mentioned in reports from the town of Falun and from Gustafs and Stora Tuna parishes. In Mora no explosion was heard, but here the meteor, which left in its path a stream of fire of a deep violet color, was seen to fall asunder in the south-southeast, with a strongly luminous fire-rain, the fire-drops of which, however, were extinguished before they reached the horizon. In Karlskoga a fire ball of a blinding clear reddish white lustre was seen high up in the zenith. Hence it sank toward the north-northwest to a height of 30°, and afterward parted into three or four small pieces, which speedily went out and resembled the stars which fall from a rocket. The meteor left behind it a white smoke, which in the calm air remained in the direction of the fall about a minute, and afterward dispersed. In the neighborhood of Karlstad the meteor was thought to fall in the northeast. It was compared to a falling star rocket. It was very bright, with a white nucleus, having fire red edges, and passing, when bursting asunder, to a blinding white, the separate pieces being clearly visible. Its apparent size was compared to that of the full moon, and after its disappearance a white streak remained for some seconds in the sky. In Hoböl parish in Dalsland there was seen in the sky a pointed fire-ball, resembling in form a soda-water flask, at first pretty high in the heavens, afterward approaching the earth, dividing into two parts, and disappearing without any detonation after the lapse of half a minute. At Lysekil the meteor appeared to fall perpendicularly in the northwest, and spring asunder, without any noise, some few feet above the surface of the water. According to a statement in the newspapers, the meteor in question was simultaneously seen at Christiania. In Denmark and Finland it was not visible.

From a careful and critical examination of these statements, and many others which have been collected, it appears that the meteor in question, possibly with the neighborhood of γ Cephei as radiation point, proceeded in a somewhat oblique direction to the place where the stones fell on the meteor bursting asunder. If with a point 40 kilometres south of Ställdalen as a center, a circle be described through Christiania, the westernmost place where the phenomenon was observed, its circumference intersects Orust in the south, the neighborhood of Stockholm in the east, and Gefle in the northeast, and includes all the places where the meteor was visible. At Stockholm, Hedemora, Karlskoga, and Lysekil, the meteor is said to have been visible first in the northeast, somewhat below the zenith, and if the direction is noted where it disappeared in the neighborhood of the horizon, this direction in general corresponds very well with the direction from the place of observation to the place of fall. The meteor thus went under the horizon or disappeared in its neighborhood at Stockholm to west, at Gefle to southwest, at Mora to south-southeast, at Lysekil to north, at Malmköping to northwest, and so on.

The meteor thus reached the end of its short luminous path in the region where the fall took place. It became luminous at a height which cannot, after making allowance for errors of observation, be reckoned at less than 300 to 400 kilometres, but was probably greater. At this height the atmosphere, notwithstanding its extreme tenuity, is capable by its resistance of heating red hot a body moving with *cosmic* speed, as of 75 kilometres per second; and if the composition of the atmosphere at this height be the same as at the surface of the earth, the meteor will meet with sufficient oxygen to maintain a lively combustion of the combustible matters which enter into the composition of the meteor. It appears to me that we have here an explanation of the considerable height in the atmosphere at which meteors first become luminous—an explanation which is much the more probable as we now not only know a number of carboniferous meteorites, but also, by the meteorite fall at Hessle, in Upland, have distinct proof that the common meteorites may be accompanied, and perhaps are generally accompanied, by an easily combustible carboniferous dust. Only through such a supposition can we obtain an explanation of the large size of these meteors when compared with the stones which fall, as well as of their strong illuminating power, which clearly shows that the light arises from the glowing of solid masses, and not merely from the compressed and heated gases which the meteor has collected before it.

The statements regarding the size of the Ställdalen meteor are very various. The most probable are those which give it a diameter of six minutes, which, supposing the distance to be 250 kilometres, would give the fire ball a diameter of 458 metres, or nearly 1,500 feet. In comparison with this size the stones that have fallen are surprisingly small, which yields a further support to the supposition that the main mass of the meteor consisted of substances which had already high up in the air been dissipated in the form of gas or undergone combustion. In the case of the Ställdalen meteor there is also the exceedingly remarkable circumstance that the fire-ball was not visible in the region where the path of the meteor struck the earth and where the meteorites fell, although this place lay nearly in the center of the area where the meteor was visible as a luminous fire-ball, and although the sky here, too, was clear and cloudless with the exception of the little dark cloud which the meteor collected before it in its path through the air. It was probably this cloud which prevented it from being seen in the region which lay in the direction of the fall. Although no fire-ball was seen here, loud detonations were heard and some light streaks of cloud were visible in the zenith, from which, according to some, faint flashes of fire resembling lightning were seen darting. Whistling, rumbling, and rattling noises were also heard. The second was thought for the most part, to come from the west or southwest. It was not heard in Karlskoga, which lies to the south, but far to the north and northwest. At Falun it was supposed that a fall of rock had taken place in a mine, and at Grandgrufvan, at Ludvika, the sound was heard as of a peal of thunder at a depth of sixty metres underground. At other places a dynamite magazine was thought to have exploded, or it was taken for a loud clap of thunder.

In the neighborhood of a workman who was cutting trees in a wood several branches of a tree were broken off by a stone weighing nearly a kilogram, in a way which clearly showed no great falling velocity, which was further confirmed by the stone making a hole in the ground only a decimetre in depth. Another person saw a stone fall close beside him, and immediately took it up. It was not at all warm. A girl saw a stone weighing two kilograms fall to the ground "so that the earth smoked." Several fell in the Lake Björken, or were picked up in the neighborhood soon after. One weighing 8½ kilograms fell in a rye-field. In falling it had gone in two pieces, and made an eight-inch deep hole in the cultivated soil. The largest stone weighed 12¼ kilograms, or 27 lbs.

The number of the stones that have been found, however, amounts only to eleven, with a total weight of thirty-four kilograms. They were scattered within an oval two kilometres broad, whose larger axis had a length of eight kilometres. The largest stone was found in the southwest end of the oval, in a meadow surrounded by wood. It is probable that larger stones have fallen farther into the wood, and thus escaped observation. The stones are of very irregular form, and on their surface are full of the depressions peculiar to meteorites. On the surface they are, as usual, covered with a blackish fused crust of very variable thickness, being so thick on some of the fractured surfaces as to completely conceal the color and inequalities of the main mass, and on other similar surfaces so thin that the color and crystalline structure of the mass may be clearly distinguished. Sometimes the crust is completely wanting, so that the surface of the stone, with the exception of an inconsiderable blackening, resembles a fresh fracture. The stones are thus fragments which have been formed at different times, and exposed for different periods to the action of the glowing envelope. The largest stones are covered in many directions with black friction surfaces which are more clearly marked on these meteorites than on any I know. These, too, have probably been formed in our atmosphere, and show that, with the great pressure produced by the resistance of the air, cracks have been formed in the meteorite along which its different parts before springing asunder rubbed against each other during the rotation of the irregularly formed mass, whereby the uneven surfaces have been smoothened, and colored black by the heat developed during friction, the projecting metallic particles flattened, etc. On breaking in pieces the meteorites in question, they are found to consist of a coarse breccia-like mixture of gray and nearly black portions, little differing from each other in chemical composition. It is remarkable that the gray mass when heated becomes dark, and thereby in appearance quite like the black, which appears to show that some of the breccia-like pieces found in the stones had been heated, while this does not appear to have been the case with the other part. Different pieces of the Ställdalen meteorites thus appear to have been exposed to the action of very different temperatures before they were united into the mass, hard, tough, and difficult to break up, which formed the meteorite.

The stones that fell at Ställdalen have been carefully analyzed by Mr. G. Lindström, assistant in the mineralogical department of the Riks Museum, who found them to consist of nickel iron; a silicate decomposed by acids, chiefly olivine; a silicate undecomposable by acids, probably bronzite; magnetic pyrites, and inconsiderable quantities of phosphide of nickel-iron; of a phosphate, and of chloride of iron. The first-named substance, a metallic alloy of ninety per cent iron and ten per cent nickel, is not known of terrestrial origin, but distinguishes most meteorites, and makes it possible to separate with certainty the meteorites which have fallen at Ställdalen from all other minerals occurring in the quarter. The two other main constituents again, olivine and bronzite, are also wanting in our granites, gneisses, and common slaty rocks, but are found commonly entering into the composition of a number of rocks, which, by the geologists and mineralogists of the present day, are considered to be of plutonic origin. Many circumstances, however, indicate that these rocks, which in remarkably regular layers cover extensive regions of the earth's surface, *often, but not always*, consist of stratified tuff like formations, which, during the enormous duration of geological periods, have assumed a crystalline structure. The resemblance between them and various constituent parts of the meteorites is so striking that the question must be seriously and impartially discussed whether a part of the plutonic rocks are not of cosmic origin. By this I mean that it gradually fell to the earth even after its surface formed an abode for animals and plants, and that under favorable circumstances it collected so as to form proper stratified so-called plutonic rocks, in which, through subsequent chemical changes, so great a development of heat has sometimes taken place that volcanic and plutonic incandescent craters have arisen in the interior of the earth.

Many observed facts may be quoted in support of this view, if it for the present appears very strange on account of the great change it would bring about in the prevailing ideas of the history of the formation of the heavenly body which we inhabit. We have perhaps here the true solution of the many disputed questions raised by the discovery of meteoric iron at Ovifak, in Greenland, a simple explanation of the abundant occurrence of magnesia in certain geological formations, and of many other geological phenomena difficult of explanation according to theories now prevalent.—*Nature*

* Abstract of an Address by Prof. Nordenskjöld at the Anniversary of the Royal Swedish Academy of Sciences.

A VISIT TO LORD ROSSE'S TELESCOPE.

A WRITER in the *English Mechanic* describes his recent visit as follows:—

Parsonstown or Birr, Ireland, as it is variously called, is a neat, pleasant, prosperous, well-built town of about 8,000 inhabitants. In the center of the market square is a Doric column 50 ft. high, surmounted with a marble statue of the Duke of Cumberland, but a more graceful, and to us a far more interesting object, is the bronze statue of the celebrated astronomer, the father of the present Lord Rosse. It stands on a granite pedestal within a railed enclosure, in the center of the principal street—a full-length figure, one hand resting on a globe. It is said to be a remarkable likeness. The features eminently display intellectuality and refinement, and the form shows dignity with strength. It is a truly fine and graceful statue.

The Earl had generously given us permission to visit his telescopes, and we were favored with the valued attendance of Mr. Drier, the resident astronomer, who courteously went with us through the observatory, and amongst the instruments. Need I tell the reader with what feelings of delight we stood before the mighty reflector, the largest which has ever been constructed, its speculum the most perfect which has yet been made—at once the grandest achievement of art and mechanical skill? The tube, which is of wood, closely banded with iron, is 60 ft. long by 7 ft. wide. The mirror is, however, a foot less in diameter. It weighs about 15 tons, is swung with a curious complication of chains and counterpoising weights, between two massive Gothic walls, so that it may be raised to the zenith, or driven through about 3° on either side of the meridian. Again, from the top of the walls movable galleries project, so that the observer may rise, or sink, or approach the tube at any required elevation. The various motions are controlled by systems of levers and screws at the command of the observer, and the mighty instrument is as much in control as a portable equatorial.

The eyepiece is fitted into the side of the tube, near the open end, in the center of which is a "flat" arranged in the usual manner. In the observatory we were shown this "flat," composed of a mixture of tin and copper, like the great speculum and bearing a lustre, I thought, singularly like the sheen of silver on glass. We did not see the great mirror; the weather being damp, the astronomer told us if it were uncased it would get dewed from the moisture of the atmosphere condensing on it, and then it must not be wiped. The powers preferably used with it vary from 400 to 600 diameters; but under some conditions of atmosphere, eyepieces magnifying 2,000 can be employed. It weighs 6 tons, and although 30 years made still remains without a rival either in size or finish; but perhaps this is less to be wondered at if we consider that this scientific achievement cost the late Earl £30,000. On every suitable night this instrument is used, the present Earl being gifted with the same love of astronomy which distinguished his father. He has lately concluded some valuable experiments on the temperature of the moon as shown by thermometers arranged in the focus of the speculum. No doubt our good friend, Mr. Birt, could tell us all about them. The records are amongst the "Transactions" of the Royal Society.

Near the colossal telescope there is a lesser instrument which would be great indeed were it not for the proximity of its greater neighbor. Its metal speculum is three feet in diameter, and 25 ft. focus. It is mounted so as to command the entire range of the heavens, and it is driven by clockwork. In the perfection of its optical parts, its exquisite definition, the smoothness, ease, and certainty of its adjustments and motion, this instrument is not surpassed, if equalled, by any in existence. At the same time it is very beautiful to look at. The designer may have been an artist as well as an astronomer; but actual perfection must ever appear picturesque and symmetrical.

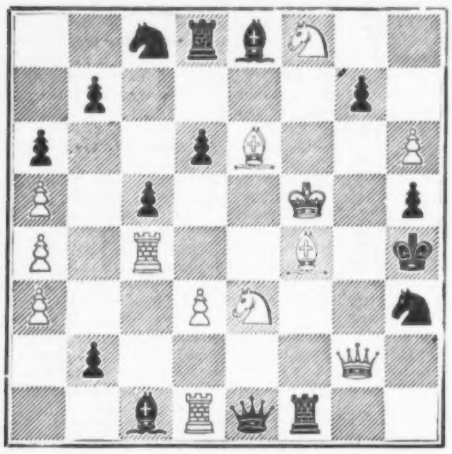
Close to those instruments is the observatory—a low domed edifice divided into three apartments, in one of which there is a Cassegrain telescope, and, for the benefit of my mechanical friends, I may tell that I saw here a 4 in. refractor, the tube of which is made of zinc, and mounted on an iron post—almost such an instrument as I or any other amateur might put together when we lay out all our money to purchase the largest object-glass, and enthusiastically hope to make the rest ourselves; but my first tube was made with brown-paper.

Scientific American Chess Record.

[All contributions intended for this department, may be addressed to Samuel Loyd, Elizabeth, N. J.]

Problem No. 15.—"A wheel within a wheel."
Dedicated to C. H. Wheeler. By Samuel Loyd.

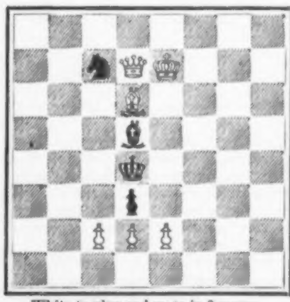
Black.



White.

White to play and mate or self mate in
Black to play and mate or self mate in TWO MOVES.

WILLIAM STEINITZ.



White to play and mate in 2 moves.
BY L. W. MUDGE.

In presenting to our readers a portrait of Mr. Steinitz, as we sketched the little giant half a score of years ago while he was working out a problem, to draw with a bishop against knight and pawn, we are strongly reminded that a long absence from the chess world has unfitted us for being able to chronicle the brilliant array of victories that he has since added to his score. We would hardly know how to begin or where to end, for the list of matches and tournaments that he has won is simply bewildering. As we progress, however, with our proposed record of the important chess events of the past, it will be readily understood why, by common consent, Mr. Steinitz has become to be looked upon as the recognized chess champion of Europe.

We have enjoyed the most friendly relations with Mr. Steinitz and found him the very pink of honor, and the most jovial little fellow in the world, ready to fight you at chess, or die sooner than give up on some little etiquetical point that he considers correct and proper. His able management of the chess department of the London *Field* is gaining him a world-wide reputation as the analyst of the day.

THE VIENNA CHESS CONGRESS OF 1873.

As a fitting accompaniment to Mr. Steinitz's portrait we give a record of this famous chess tournament, as well as the decisive game played in the tie for the first prize between himself and Blackburne.

The following was the result of the tournament concluded on the 29th of August, 1873:

First Prize of 200 ducats, offered by the Emperor of Austria, and 1,000 florins, won by Mr. Steinitz, scoring 10 games; Second Prize, 600 florins, by Mr. Blackburne, 10 games; Third Prize, 400 florins, by Mr. Anderson, 8½ games; Fourth Prize, 200 florins, by Mr. Rosenthal, 7½ games.

The other players won as follows:

Louis Paulsen and Mr. Bird, each 6½ games; Fleissig and Meitner, each 3½ games; Gelbfuhs, Heral, and Schwarz, each 3 games; Pitchel, 1 game.

(IRREGULAR OPENING.)

WHITE. Steinitz.	BLACK. Blackburne.
1. P to Q R 3 (*a*)	1. P to K Kt 3 (*b*)
2. P to Q 4	2. B to K Kt 2
3. P to K 4	3. P to Q B 4 (*c*)
4. P x P	4. Q to Q B 2
5. B to Q 3	5. Q x P
6. Kt to K 2	6. Kt to Q B 3
7. B to K 3	7. Q to R 4 ch
8. Kt to Q B 3	8. P to Q 3
9. Castles (*d*)	9. B to Q 2
10. P to Q Kt 4	10. Q to Q sq
11. R to Q Kt sq	11. P to Q Kt 3
12. Kt to Q 5	12. Kt to K B 3
13. Kt x Kt	13. B x Kt
14. B to K R 6	14. Kt to K 4 (*e*)
15. P to K R 3	15. R to K Kt sq
16. P to K B 4	16. Kt to Q B 3
17. Q to Q 2	17. Q to Q B 2
18. P to Q B 4	18. Kt to Q sq
19. K R to Q B sq	19. Kt to K 3
20. Kt to Q B 3	20. Q to Q Kt 2
21. Kt to Q 5	21. B to K R sq
22. K to K R sq	22. R to Q B sq
23. Q to K B 2	23. B to Q B 3
24. Q to K R 4	24. Kt to Q 5
25. B to K Kt 5	25. B x Kt
26. B P x B	26. K to Q 2
27. B x P	27. R x R ch
28. R x R	28. R to Q B sq
29. R to Q sq	29. R to Q B 6
30. B to K B 6	30. Q to Q B sq
31. Q to K Kt 4 ch	31. Kt to K B 4
32. B to Q Kt 5 ch	32. K to B 2
33. B x R	33. P to K R 4
34. Q to K B 3	34. Kt to K R 5
35. B x B	35. Q x B
36. R to Q B sq ch	36. K to Kt sq
37. Q to Q B 3	37. Q to Q sq
38. B to Q R 6, and Mr. Blackburne resigns.	

(*a*) Anderson played this move to good advantage against Morphy, winning one game, losing the second and drawing the third. The authorities, however, maintain that it loses the advantage of the first move.

(*b*) Mr. Morphy replied with P to K 4, which is certainly a much stronger move; the other defence permits of a more rapid development of the white forces.

(*c*) For the purpose of breaking up the adverse center, but as it necessitates a premature advance of the queen, to recapture the pawn, the white gains an invulnerable position.

(*d*) The whites are now admirably disposed, and skillfully prevent the adverse king from castling.

(*e*) A most excellent move.

Mr. Preti, to whom we are indebted for this game, adds that Mr. Steinitz has manœuvered his forces from the very beginning in a most remarkable manner.

STEINITZ AND ZUCKERTORT.

The following fine game was the concluding one of the match between Messrs Steinitz and Zuckertort, played in London during the months of August and September, 1872. The result of the contest being Steinitz, 7; Zuckertort, 1; and 4 drawn.

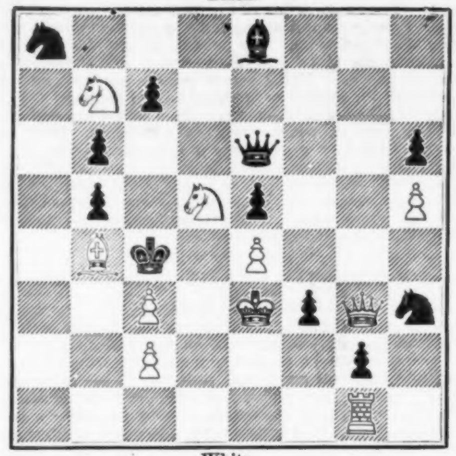
WHITE. Steinitz.	BLACK. Zuckertort.
1. P to Q 4	1. P to K B 4
2. P to K Kt 3	2. Kt to K B 3
3. B to K Kt 2	3. P to K 3
4. Kt to K B 3	4. B to K 2
5. Castles.	5. Castles.
6. P to Q B 4	6. Q to K sq
7. Kt to Q B 3	7. P to Q 4
8. Kt to K 5	8. P to Q B 3
9. P to Q Kt 3	9. Kt to K 5
10. B to Q Kt 2	10. Kt to Q 2
11. Kt to Q 3	11. Q Kt to K B 3
12. Q to Q B 2	12. B to Q 3
13. Kt x Kt	13. B P x Kt
14. Kt to K 5	14. B x Kt
15. P x B	15. Kt to K Kt 5
16. P to K R 3	16. Kt to K R 3
17. P to K Kt 4	17. Q to K 2
18. P to K B 3	18. K P x P
19. K P x P	19 B to Q 2
20. P to K B 4	20. Q to Q B 4
21. K to R sq	21. P to Q Kt 4
22. Q R to Q sq	22. Kt P x P
23. B to Q 4	23. Q to K 2
24. P x P	24. P to Q R 4
25. Q to K B 2	25. K R to Q B sq
26. B to Q B 5	26. Q to K sq
27. K R to K sq	27. Q R to Q Kt sq
28. P to K B 5	28. K P x P
29. P to K 6	29. B x P
30. B P x P	30. K B P x P
31. R x B	31. Q to K R 4
32. Q P x P	32. P to K Kt 6
33. Q to Q 4	33. Kt to K B 4
34. Q to Q 5	34. K to R sq
35. R to K 5, and black resigns.	

AMATEUR WORLD PROBLEM PRIZE.

We extract from a recent number of the *Amateur World* the clever little problem by Sergt. Woods, to which has been awarded the prize for the best three move problem, received in competition for what was known as the "Experimentum Prize," offered by a correspondent of that enterprising Journal.

Problem No. 16.—By Color Sergt. H. Woods, Chichester, England, winner of the London Amateur World "Experimentum Prize."

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 7.—By S. Loyd.

WHITE.	BLACK.
1. Q to K Kt 3	1. B to K B 6
2. Q to K Kt 8	2. Any move.
3. Q mates	
	1. B to Kt 6 or K to R 3
2. Q x P	2. Any move
3. Q mates	
	1. K to R 5
2. Q to Q B 3	2. B moves
3. Q to Kt 4 mate	

No. 8.—By S. Loyd.

WHITE.	BLACK.
1. Q to K R 8	1. R to B 6 ch
2. K to B 2 ch	2. P to Q 5
3. Q to Q R 8 ch	3. R to R 6
4. Q x R mate	
	1. K moves
2. Q x R	2. K to R 2 (or Kt sq)
3. Q to K B 2 (or Q Kt 6) ch	3. K moves
4. Q mates	

Letter "B."—By Dr. C. C. Moore.

WHITE.	BLACK.
1. P to B 8 (becomes a Kt)	1. P to Q 3
2. Kt to Q 8	2. Any move
3. Mates	
	1. P x P
2. Q x B P ch	2. K to K 3
3. Kt x Q B P mate.	

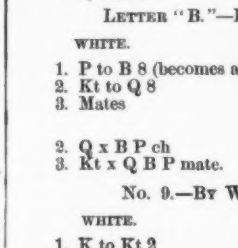
No. 9.—By W. A Ballantine.

WHITE.	BLACK.
1. K to Kt 2	1. K to K 5
2. R to K 7	2. K to Q 3
3. Q to Q 4 ch	3. K to B 3
4. Q to Q 7 mates	
	1. K to Q 3
2. R to B 4	2. K to Q 4
3. Kt to B 7 ch	3. K x R
4. Q to B 3 mate	
	1. P to Kt 4
2. Kt to K B 5	2. K to B 5
3. Q to K B 3	3. Moves
4. Q mates	
	1. P to R 4
2. Kt to K Kt 5	2. Any move
3. Q to K 6 ch	3. K to Q 5
4. Q to K 4 mate	

No. 10.—By W. A. Ballantine.

WHITE.	BLACK.
1. B to K 6	1. K x B
2. Q x P	2. K to Q 4
3. Kt to K 2	3. K to K 2
4. Kt to B 4 mate	
	1. K to B 3
2. Kt to K 4	2. K to Kt 4
3. Q to B 5 ch	3. K moves
4. B or Kt mates	

SCIENTIFIC QUEEN PROBLEMS.



We give this week the solution to No. 1 of our queen problems, showing how the queen can be passed over every square of the chess board, returning to the starting point, in fourteen moves. Commence by placing the queen on any one of the angles, such as B, Kt, or R sq, and move on the white lines until they lead back to the point of beginning. The answers to the other problems will be given next week.

A host of correspondents will be attended to next week; in the meantime a score of friends are informed that back numbers can be obtained direct from the office.